United States Court of Appeals

for the Second Circuit

APPENDIX

75-7621
75-7645

No. 75-7621
No. 75-7645

B
P/S

IN THE

United States Court of Appeals

FOR THE SECOND CIRCUIT

PLANTRONICS, INC.,

Plaintiff-Appellant and Cross-Appellee,

v.

ROANWELL CORPORATION,

Defendant-Appellee and Cross-Appellant.

APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

JOINT APPENDIX – EXHIBIT VOL. I
(Exhibits 1 – 121)
(Pages 1 – 399)

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PAGINATION AS IN ORIGINAL COPY

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Numbered= Introduced by Plaintiff
Lettered= Introduced by Defendant

* Page numbers on exhibits are informal and are circled.

DEFENDANT'S EXHIBITS

EXHIBIT
1

U. S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

October 15, 1974
(Date)

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of the Printed Specification and Drawings of U. S. Patent [illegible],184,556.

By authority of the
COMMISSIONER OF PATENTS

Certifying Officer.

Ex. 1 1

3,184,556

MINIATURE HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

Wallace Keith Larkin, Santa Cruz, Calif., assignor to Pacific Plantronics, Inc., a corporation of California

Filed Dec. 11, 1961, Ser. No. 158,463
6 Claims. (Cl. 179—156)

This invention relates to miniature type sound translating apparatus which is provided with a tuned acoustical tube to improve the frequency response characteristic and also to enable the apparatus to be used either with or without masks such as oxygen masks employed by airline pilots.

An object of this invention is to provide an improved sound translating apparatus adapted to be used with communications apparatus employed in vehicles such as airplanes in which the pilot is sometimes required to wear a mask such as an oxygen mask.

Still another object of this invention is to provide a tuned acoustical tube with a miniature type microphone to mechanically alter the frequency response of the microphone by removal of certain objectionable frequencies and also to alter the microphone primary frequency response curve.

A further object of this invention is to provide an improved arrangement for attaching a sound translating device, such as is used by airline pilots, to the temple bar of sun glasses or other glasses worn by the pilots.

Still another object of this invention is to provide an improved sound translating apparatus that may be worn by an airline pilot and which is provided with means whereby a mask, such as an oxygen mask, which the pilot may have to wear occasionally, does not interfere with the transmission of the pilot's voice to the microphone which is supported on the temple bar of the glasses worn by the pilot.

Still another object of this invention is to provide an improved arrangement for supporting the microphone near the user's ear, said microphone being provided with a plastic acoustic tube having an air column therein the open end of which is adapted to be positioned adjacent to a corner of the user's mouth, or attached to a diaphragm cavity of the oxygen mask when such mask is worn by the user of the microphone.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawings in which briefly:

FIG. 1 is a view showing this invention employed in combination with an oxygen mask;

FIG. 2 is a view of this invention employed without the oxygen mask;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a side view of the fitting provided for supporting the microphone and receiver;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a detailed view showing the manner in which the fitting shown in FIGS. 4 and 5 is supported on the temple bar of the pilot's eyeglass frame, a portion of the temple bar being shown in broken lines;

FIG. 7 is an end view of the fitting shown in FIGS. 4, 5 and 6; and

FIG. 8 is a schematic view of the pilot's and co-pilot's compartment in an aircraft showing the manner in which this invention is adapted to be used.

Referring to the drawing in detail, there is shown in FIG. 1 an embodiment of this invention employed in combination with an oxygen or smoke mask such as is provided to airline pilots, navigators and other personnel having communications responsibilities. In FIG. 2 there is shown an embodiment of this invention employed by the communications apparatus operator or pilot after removal of the mask. The small fitting 10 which may be made of metal or plastic material is provided for the purpose of supporting a microphone and telephone receiver or other sound translating apparatus or transducers on the temple bar 11 of the eyeglass frame worn by the operator or pilot. A spring clip device 12, such as shown in FIGS. 5, 6, and 7, is provided for this purpose. The clip 12 is shaped so that the end portions 13 and 14 thereof form hooks which clip over one side of the temple bar 11, as illustrated by the hook 14 shown in FIG. 7, and the middle part 15 of this spring clip is bent back upon itself as shown in FIG. 6 to form an opposing hook adapted to be clipped over the other side of the temple bar 11, also as shown in FIG. 7.

The fitting 10 is provided with a button member 17 which extends from the inner side of this fitting and which is provided with a keystone shaped portion 17a that is anchored in a suitable cavity in the fitting 10 by means of the cement, plastic or other potting material 18 as shown in FIG. 5. The projecting portion of this button 17 is provided with a circumferential groove in which the arcuate portions 15 and 16 of the clip member 12 are adapted to be resiliently lodged as shown in FIGS. 5 and 6. Thus the fitting 10 may be detachably attached to the temple bar 11 and it may also be detached from the clip member 12 if desired.

The fitting 10 is also provided with additional cavities for receiving the transducers 19 and 20 which comprise the microphone and receiver of a communications apparatus such as is employed by the pilot and co-pilot of an aircraft. These devices 19 and 20 are positioned in their respective cavities in the fitting 10 and they are held therein by a thin layer of plastic, cement, or potting material 21 and 22 respectively. Both the microphone 19 and receiver 20 are of the miniature type such as are used in hearing aids.

The microphone 19 is provided with a short tubular extension 23 which is hollow and to which the cap 24 is adapted to be attached. Thus the projection 23 extends into the cavity 25 of the cap 24 so that sound transmitted through the plastic or other flexible tube 26 and tubular connection 27 into the cavity 25 passes through the hollow extension 23 into the microphone 19. A suitable flexible or resilient gasket 23a may be provided between the cap 24 and the extension of projection 23 of the microphone and this gasket is preferably sufficiently flexible or resilient to hold the cap 24 assembled on the microphone and also to permit the cap 24 to be rotated with respect to the microphone 19.

The receiver 20 is also provided with a hollow extension or projection similar to the projection 23 of the microphone 19 so that sound generated in the receiver 20 may be readily passed into the cavity of the cap 28 which is similar to the cap 24. The ear tube 29 is attached to the cap 28 by means of the coupling member 30 so that the sound from the cavity of the cap 28 is passed through this ear tube 29 into the operator's ear.

The plastic tube 26 is made of yieldable material which may be formed into predetermined shape so that the lower end thereof may be placed either in the fitting 31 of the mechanical microphone that is supported on one side of the oxygen mask as shown in FIG. 1, or this lower part of the plastic tube 26 may be positioned at the corner of the operator's mouth as shown in FIG. 2, when the operator does not wear the oxygen mask. The mechanical microphone unit positioned in the mask is intended to eliminate the conventional electrical microphone which is

(2)

now an integral part of the oxygen and smoke masks used in military and commercial jet aircraft.

The fitting 31 in which the lower end of tube 26 is positioned is shown in cross-section in FIG. 3 and it is threaded to the tubular hollow member 32 to which the lower end of the plastic tube 26 is adapted to be frictionally attached. The mask is made up of an outer body member 33 which may be made of relatively rigid material and an inner lining 34 of resilient material such as rubber. The tubular member 32 extends through both of these layers 33 and 34, as shown in FIG. 3, and is integral with the diaphragm housing member 35 of the mechanical microphone so that one side of this member is clamped against the resilient liner 34 of the mask when the fitting 31 is tightened up against the outer mask member 33. The tubular member 32 is provided with a hollow channel 36 which communicates with the compartment 37 behind the diaphragm 38 and it also communicates with the channel through the plastic tube 26. A diaphragm 38 is held in the member 35 on the shoulder 35a by the cap 39 which is provided with an inner annular member that is adapted to engage the peripheral outer part of the diaphragm and press this diaphragm against the shoulder 35a. Cap 39 is also provided with an outer annular portion 39b which is threaded to the outside of the diaphragm housing 35.

A plurality of holes 40 is also provided to the central portion of the cap 39 so that sound may readily enter the inside of this cap to impinge the diaphragm 38. Thus sound vibrations impinge the diaphragm 38 and vibrate the air column extending all the way from the inner surface of the diaphragm 38 to the surface of the diaphragm (not shown) in microphone 19. The air column starting in the microphone cavity 25 and passing through fitting 27, plastic tube 26 and tubular member 32, which opens into the diaphragm cavity 37 of the mechanical microphone provides acoustic tuning to the miniature type microphone and alters mechanically the frequency response of the microphone. The tube 26 is preferably made of irradiated polyolefin plastic such as polypropylene made by the Alpha Wire Company and the desired acoustic tuning for the miniature type microphone is accomplished by controlling the length, diameter and wall thickness of this tube. The use of such a tuned acoustical system with a miniature type microphone is done for the specific purpose of removing a series of inherent deficiencies due to the miniature size of these microphones which has previously precluded their use in general audio communication applications.

Thus the tuned acoustical tube in this invention functions to substantially remove certain objectionable frequencies or bands of frequencies prominent in background noises in any specific environment and it also functions to alter the primary frequency response curve of the microphone particularly in the lower spectrum to allow use of the miniature type microphone in areas of voice communication, such as, aircraft, switchboard, teaching machines, etc., where space and weight savings are important.

In some installations, it may be desirable to provide a small opening from cavity 37 to the exterior through the wall of the housing 35 so that air pressure therein may be equalized to the air pressure in the gas mask, or oxygen mask. This small opening, however, should not be so large as to compare in cross-section with the cross-sectional area of the passage 36.

One of the advantages of this invention is that the microphone 19 and receiver 20 may be worn on either side of the operator's head. Thus the pilot sitting in seat 41 in the aircraft pilot's compartment, shown in FIG. 8, may wear the microphone and receiver on the right hand side of his head and the spring clip 12 that is provided for attaching the fitting 10 to the temple bar 11 is constructed so that this fitting may be attached either to the right hand temple bar or to the left hand temple bar as desired. Also the cap 24 for the microphone and cap 28 for the receiver are adapted to rotate with respect to these elements so that the plastic tubes 26 and 29 attached thereto may be positioned at the desired angles with respect to the fitting 10. Thus the pilot occupying seat 41 has the electrical connections 44 from his microphone and receiver connected to the communication apparatus coupling box 42 which is attached to the fuselage of the aircraft, and the co-pilot occuppying the seat 42 being provided with a microphone and receiver attachment on the left hand side of his head has the electrical connections 45 thereto coupled to the coupling box 43 of the communications apparatus.

While I have shown and described a preferred embodiment of the invention, it will be understood that the invention is capable of variation and modification from the form shown so that its scope should be limited only by the scope of the claims appended hereto.

What I claim is:

1. A miniaturized microphone headset employing a miniature microphone and a miniature receiver, comprising the combination of support means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear, a first acoustical tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being adapted to be positioned adjacent to the wearer's mouth, a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear.

2. A miniaturized microphone headset according to claim 1 wherein said first acoustical tube is made of yieldable plastic material.

3. A miniaturized microphone headset according to claim 1 wherein said first acoustical tube is made of polyolefin plastic.

4. A miniaturized microphone headset according to claim 1 and adapted for use with a pair of eye glasses wherein the support means include clip means adapted to grip the temple bar of said eye glasses.

5. A miniaturized microphone headset according to claim 1 and combined with a mask comprising a chamber mounted in said mask and a diaphragm positioned within said chamber, the end of the first acoustical tube remote from said microphone being acoustically connected to said chamber.

6. A miniaturized microphone headset employing a miniature microphone and a miniature receiver and combined with a mask, said headset comprising: means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear, an acoustical tube, means for attaching one end of said tube to said microphone, a chamber mounted in said mask, a diaphragm mounted within said chamber, and means for acoustically coupling the other end of said tube to said chamber.

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ROBERT H. ROSE, *Primary Examiner*.

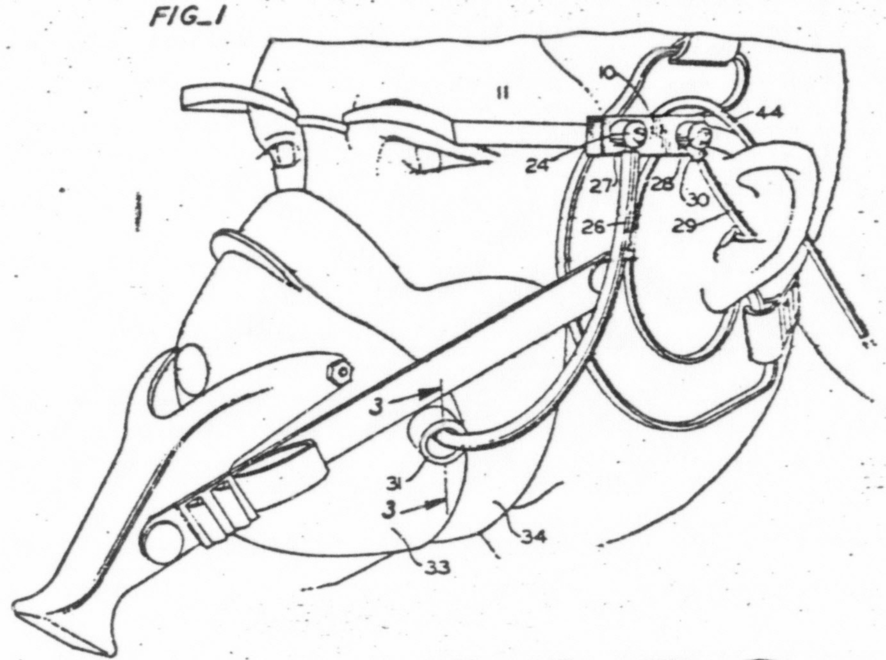
WILLIAM C. COOPER, *Examiner*.

May 18, 1965 W. K. LARKIN 3,184,556

MINIATURE HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

Filed Dec. 11, 1961 2 Sheets-Sheet 1

FIG_1



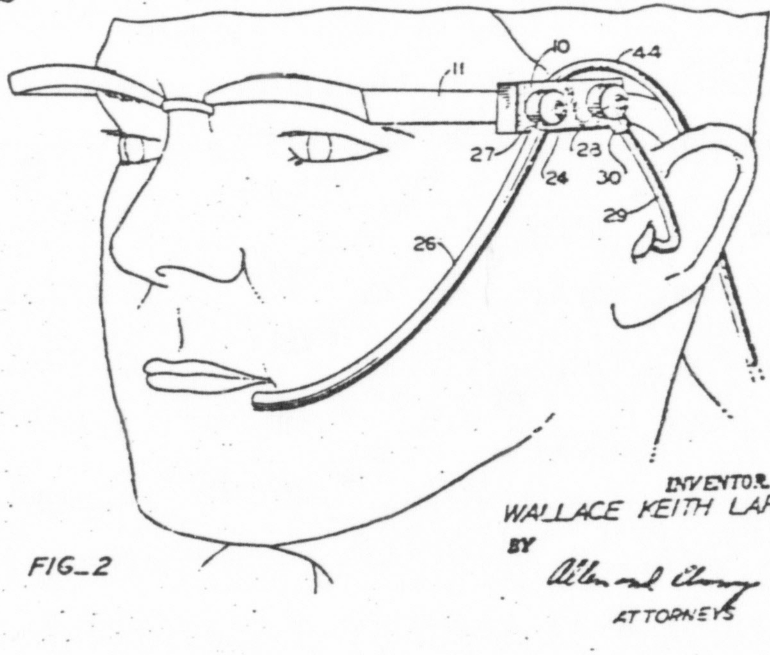


FIG_2

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BY
Allen and Chromy
ATTORNEYS

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May 18, 1965 W. K. LARKIN 3,184,556

MINIATURE HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

Filed Dec. 11, 1961 2 Sheets-Sheet 2

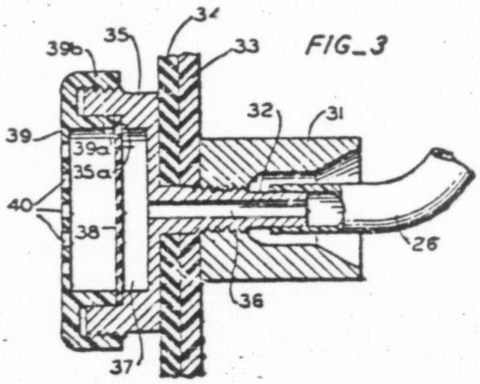


FIG_3

FIG_7

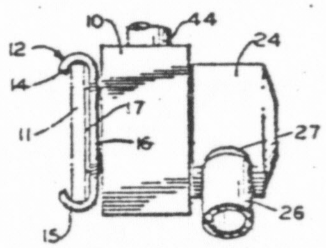


FIG_4

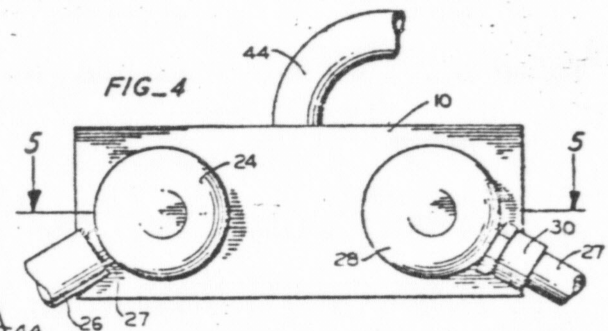
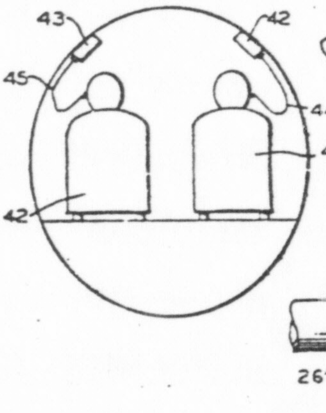


FIG_8



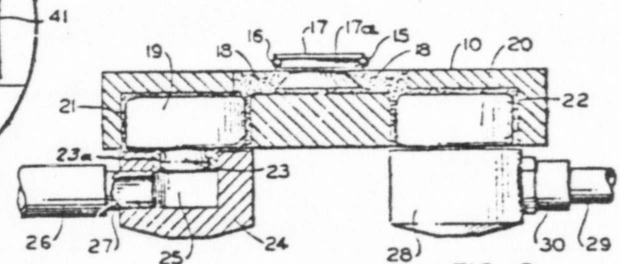
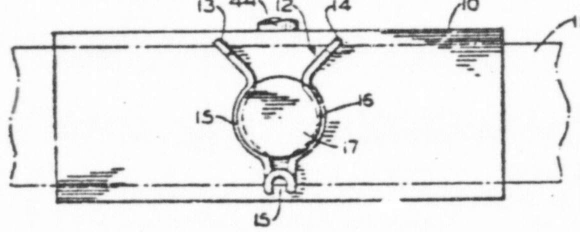


FIG_5

FIG_6



INVENTOR
WALLACE KEITH LARKIN

BY

Allen and Chromy

ATTORNEYS

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EXHIBIT

2

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HIS IS TO CERTIFY that the annexed is a true copy from the records of this office
the Printed Specification and Drawings of U. S. Patent
548,118.

By authority of the
COMMISSIONER OF PATENTS

Ella L. Courtney
Certifying Officer.

6

ɹited States Patent

[11] 3,548,118

[72] Inventor Kenneth J. Hutchings
Soquel, Calif.
[21] Appl. No. 839,016
[22] Filed July 3, 1969
[45] Patented Dec. 15, 1970
[73] Assignee Pacific Plantronics, Inc.
Santa Cruz, Calif.
a corporation of California

[54] SELF-SUPPORTING HEADSET
7 Claims, 4 Drawing Figs.

[52] U.S. Cl. 179/156
[51] Int. Cl. H04m 1/05
[50] Field of Search 179/156

[56] References Cited

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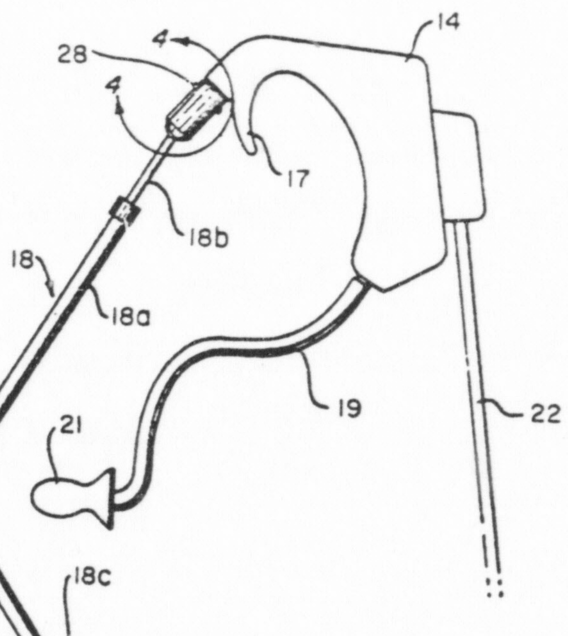
Primary Examiner—William C. Cooper
Attorney—Flehr, Hohnach, Test, Albritton & Herbert

ABSTRACT: A self-supporting headset having a housing which accommodates a receiver and microphone. A flexible acoustic tube adapted to communicate between the auditory canal of the ear of the user and the receiver secured to the bottom of the housing, and an adjustable acoustic tube secured to the top of the housing with its distal end adapted to be disposed adjacent the mouth of the user to transmit sound to the microphone.



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SELF-SUPPORTING HEADSET

BACKGROUND OF THE INVENTION

This invention relates generally to headsets and more particularly to headsets which contain a microphone and receiver and are adapted to be supported solely from the ear of the user.

Some prior art headsets have included various intermediate supporting structures for supporting the headset in cooperative relationship with the ear a[illegible]d mouth of the user. Such structures have included head bands and means for attachment to the temple of eyeglasses. These structures have been rather cumbersome. Others have included ear molds for supporting the headset from inside the ear. This necessitates fitting of the ear mold to individual users.

SUMMARY OF THE INVENTION AND OBJECTS

It is a general object of the present invention to provide a lightweight headset which can be comfortably and securely worn, for example, by telephone operators, radio operators, aircraft personnel or other persons using communications systems.

It is another object of the present invention to provide a headset which is capable of being fitted to the user without undue individual attention.

It is a further object of the present invention to provide a headset which is shaped and constructed to be worn comfortably and stably behind the ear of a wearer.

In general, the above and other objects of the invention are achieved by a headset which comprises a housing adapted to be placed behind the ear of the wearer and including an upper curved extension which extends over and engages the top of the ear. A microphone and a receiver are disposed within the housing. An extensible voice tube is attached and positionably supported from the top of the housing with its distal end adapted to be placed adjacent the mouth of the wearer whereby sound can be transmitted from the mouth to the microphone and a flexible acoustic tube is secured to the bottom and provides communication between the auditory canal of the ear and the receiver.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the self-supported headset of the present invention in position upon a user's ear.

FIG. 2 is an enlarged side elevational view of the headset.

FIG. 3 is an enlarged view of the headset with one side of the housing removed to show the internal position of the microphone and receiver and the attachment of the acoustic tubes to communicate therewith.

FIG. 4 is an enlarged view taken along the line 4—4 of FIG. 2 showing the ball and socket connection of the voice tube.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a user 11 is shown with the headset 12 mounted behind his ear 13. The headset includes housing 14 which fits comfortably behind the ear as indicated by the dotted outline 16. The top of the housing 14 includes a horn or projection 17 which extends over the top of and engages the top of the ear to hold the housing 14 in a place behind the ear.

The top of the housing 14 supports an extensible voice tube 18 which projects forward from the top of the ear towards the mount of the user with the distal end adjacent the mouth. A flexible acoustic tube 19 is secured to the bottom of the housing and carries ear insert 21. The acoustic tube 19 provides communication between the auditory canal of the ear and the receiver. An electrical cable 22 depends downwardly from and is secured to the back of the housing.

Referring more particularly to FIG. 2, the voice tube 18 includes telescoped portions $18a$ and $18b$ whereby th[illegible] 18 may be extended or retracted to place the distal e[illegible]jacent to the user's mouth. The tube 18 is supported [illegible] housing 14 by a ball and socket joint more clearly shown in

FIG. 4. Thus, the portion $18b$ is provided with a ball 23 accommodated within socket 24 fitted to the tube 26. The tubes 18 and 26 provide communication between the user and the associated microphone. A ferrule 27 surrounds the ball and socket 23 and 24 and is adapted to detachably secure the voice tube 18 to the housing 14. This is achieved by inserting the ferrule and rotating the ferrule to engage the pins 28. Referring more particularly to FIG. 3, the tube 26 is connected to a flexible tube 29 secured to the microphone 31. The flexible tube 29 serves to isolate the microphone 31 from any motion of the housing 14. The tube 26 is held in the housing by epoxy 32 and by the housing when the headset is assembled. The microphone transducer 31 is supported by a resilient boot 33 which serves to support the microphone within the housing and to isolate the same from vibrations of the housing and to decouple the microphone from the receiver.

The flexible tube 19 is supported by grommet member 34 and communicates with the receiver 36. The receiver 36 is also resiliently supported within the housing by a resilient boot 37. The boot likewise serves to isolate the receiver from the microphone and from other vibrations.

The housing 14 may comprise two mating parts which are affixed to one another as, for example, by sonic bonding, pins, or the like. The housing provides receptacles for receiving the microphone and receiver-transducer 31, 36 as indicated.

The cable 22 is secured to the housing by a cover 38 acting in conjunction with the member 39 to form an opening and strain relief 41 secured to the cable and having projection 42. The microphone lead wires 43, 45 extend from the cable and are secured to a pair of pins 44. Receiver leads 46, 47 extend from the cable 22 and are secured to a pair of pins 48. The lead wires from the microphone and from the receiver are attached to socket members (not shown) and are connected to the leads 43, 45 and 46, 47 via pins 44 and 48 when the member 39 is seated within the housing. The socket assembly is held by screw 49 which extends downwardly and engages the nut 51.

Referring now to FIGS. 1 and 2, it is seen that the headset is self-supporting on the operator or user's ear. The headset fits behind the ear with the projections 17 extending over and engaging the top of the ear. The telescoped voice tube 18 is secured to the top of the housing by a ball and socket joint whereby the tube can be extended and positioned adjacent the wearer's mouth. The weight of the tube serves to provide a counterclockwise torque to the housing. The flexible tube 19 extends into the ear and provides negligible torque to the housing. However, the cable 22 which depends downwardly has its weight acting on the housing to provide a clockwise torque. The counterclockwise torque provided by the voice tube and the holding action of the protrusion 17 serves to overcome the clockwise torque and to stably hold the headset behind and under the ear of the user. Thus, it is seen that there has been provided a lightweight stably supported headset.

I claim:

1. A headset comprising a housing adapted to be placed behind the ear of a user, said housing including an integral upper curved extension adapted to extend over and engage the top of the ear, a microphone disposed in and near the top of said housing, a forwardly extending voice tube communicating with said microphone and positionably secured to the upper extension of said housing, said voice tube being adapted to have its distal end positioned adjacent the user's mouth, a receiver disposed in and near the bottom of said housing, and a flexible tube secured to the bottom of the housing and adapted to provide communication to the auditory canal of the user's ear.

2. A headset as in claim 1 including a cable secured to the back of said housing for connection to the microphone and receiver.

3. A headset as in claim 1 in which said voice tube is supported from the housing by a ball and socket joint.

4. A headset as in claim 3 in which said voice tube includes first and second telescoped sections.

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5. A headset comprising a housing, a microphone and a receiver disposed in said housing, said housing being shaped to fit behind the ear of a user, said housing including an upper curved extension adapted to extend over and engage the top of the ear, a forwardly extending voice tube secured to the upper portion of the housing adjacent said curved extension with its distal and adapted to be positioned adjacent the wearer's mouth, said curved extension bearing on the ear whereby the weight of the voice tube provides a torque which counteracts the torque introduced by the weight of the housing to balance the headset and securely hold the same on a wearer's ear.

6. A headset as in claim 5 including a cable secured to the back of the housing and depending downwardly therefrom providing an electrical connection to the microphone and receiver.

7. A headset as in claim 5 including a flexible tube secured to the bottom of the housing and adapted to provide communication between the auditory canal of the user and the receiver.

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PATENTED DEC 15 1970

3,548,118

SHEET 1 OF 2

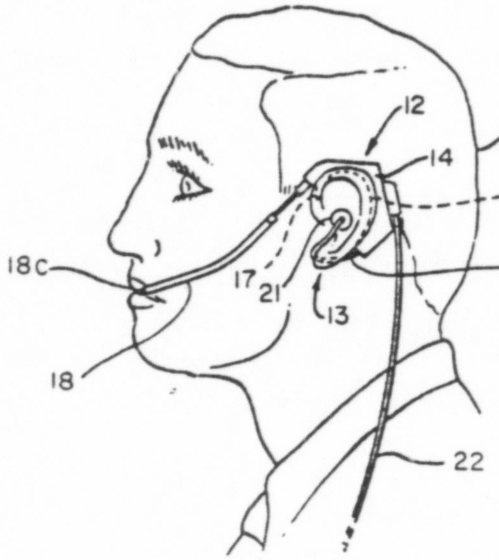

FIG. 1

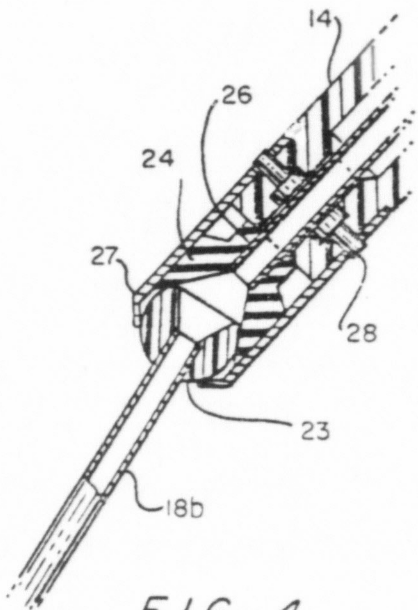

FIG. 4

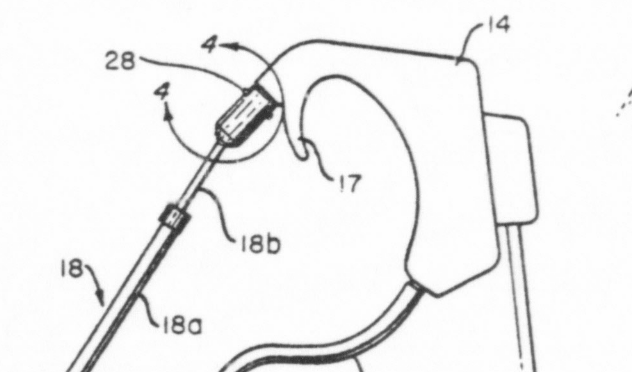

FIG. 2

KENNETH J. HUTCHINGS
INVENTOR

BY [illegible signature]
ATTORNEYS

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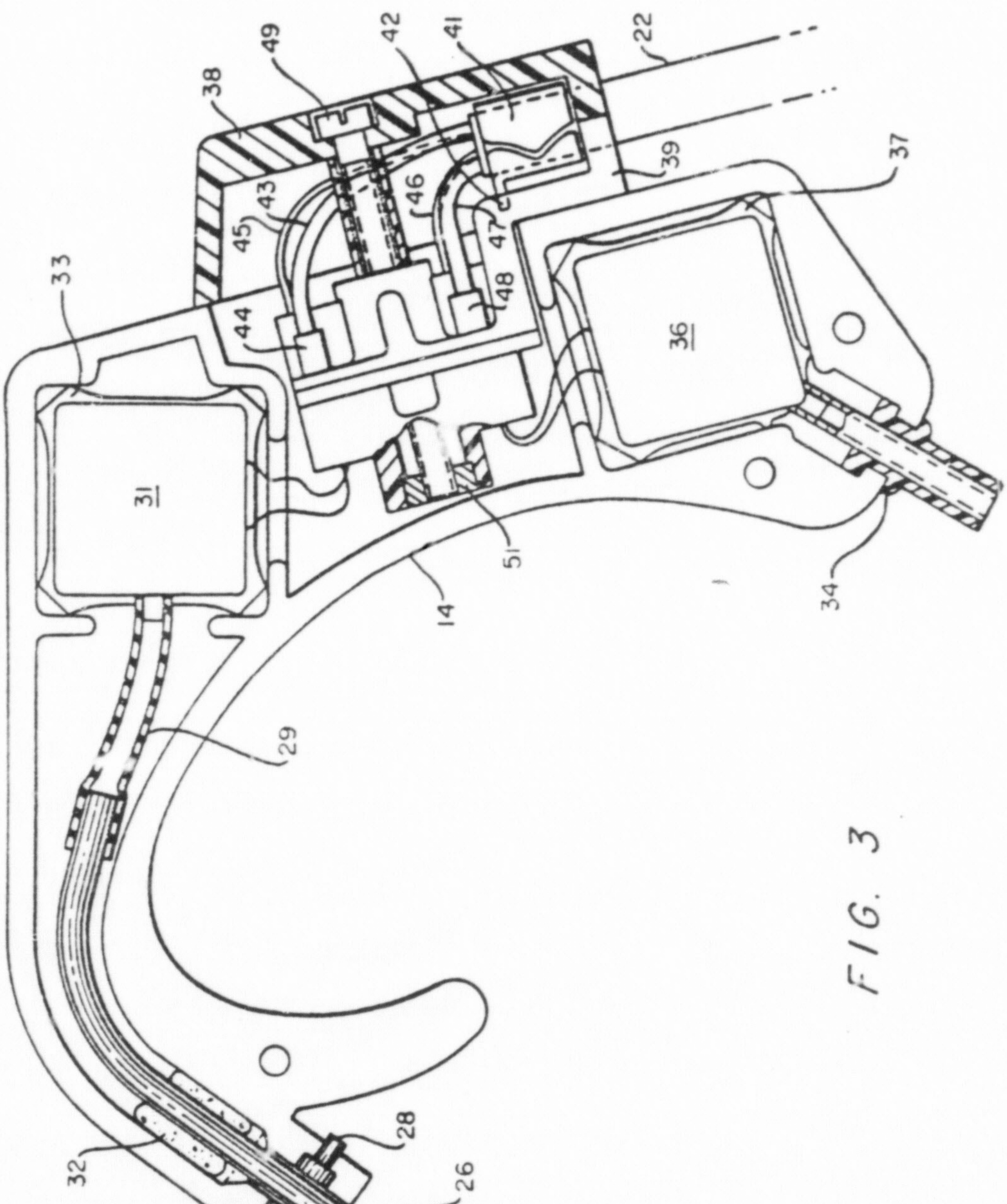


FIG. 3

KENNETH J. HUTCHINGS
INVENTOR.

BY [illegible]

ATTORNEYS

(11)

U. S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

3

October 15, 1974
(Date)

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of the Printed Specification and Drawings of U. S. Design Patent 218,173.

By authority of the
COMMISSIONER OF PATENTS

Ella L. Courtney
Certifying Officer.

Ex. 3 12

United States Patent Office

Des. 218,173
Patented July 28, 1970

218,173

COMBINED MICROPHONE AND RECEIVER INSTRUMENT

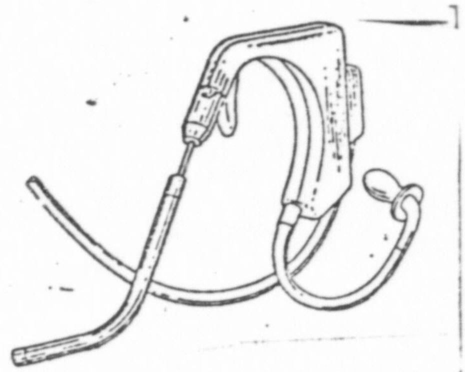
Kenneth J. Hutchings, Soquel, Calif., assignor to Pacific Plantronics, Inc., Santa Cruz, Calif., a corporation of California

Filed June 16, 1969, Ser. No. 17,718

Term of patent 14 years

Int. Cl. D14—01

U.S. Cl. D26—14



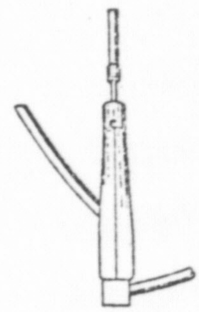


FIG. 4

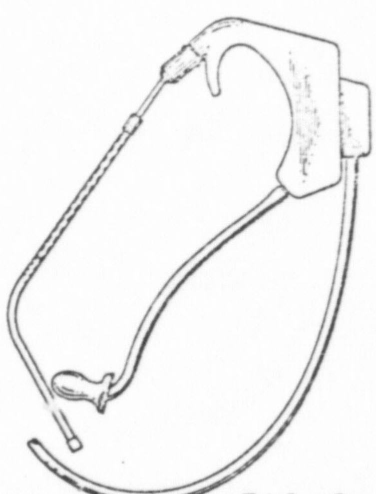


FIG. 2

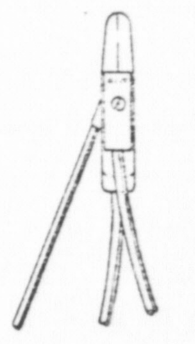


FIG. 3

FIG. 1 is a perspective view of the combined microphone and receiver instrument:

FIG. 2 is a side elevational view of the combined microphone and receiver instrument:

FIG. 3 is a rear elevational view of the combined microphone and receiver instrument; and

FIG. 4 is a top plan view of the combined microphone and receiver instrument.

The tubular members are fragmentarily shown for ease of illustration.

I claim:

The ornamental design for a combined microphone and receiver instrument, substantially as shown and described.

References Cited

UNITED STATES PATENTS

D. 159,223	7/1950	Olson	D26—14
2,993,962	7/1961	Hothem	179—156
3,327,807	6/1967	Mullin	181—23

BERNARD ANSHER, Primary Examiner

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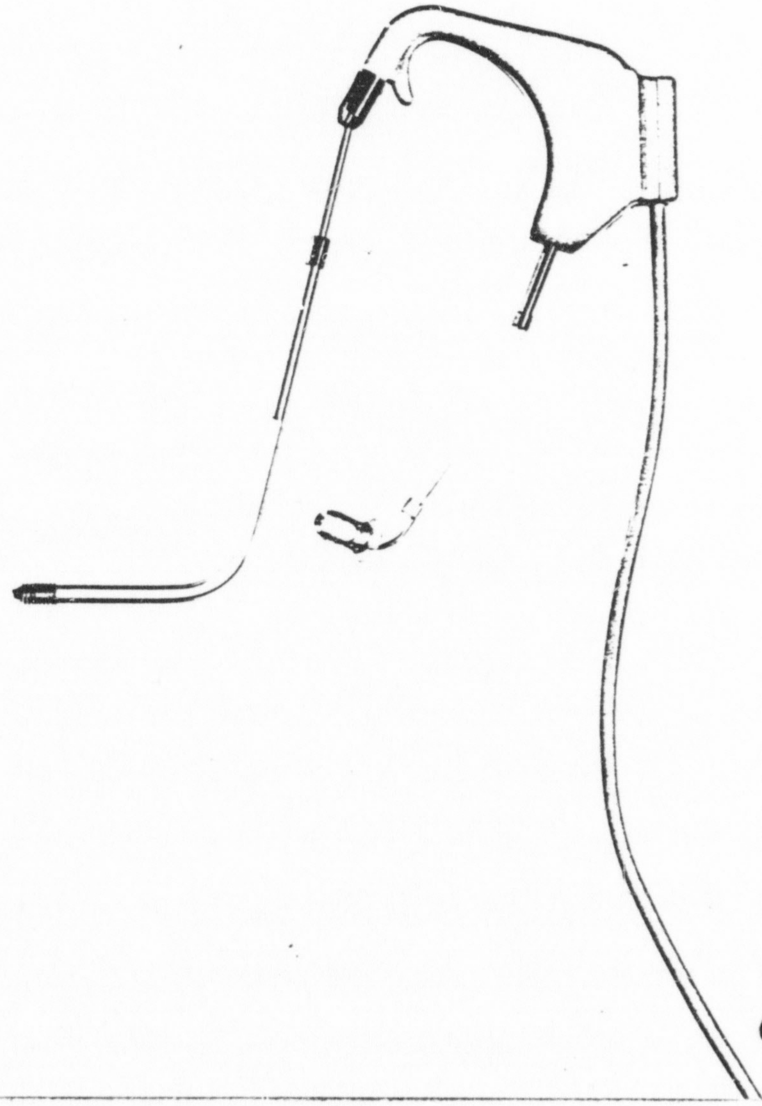
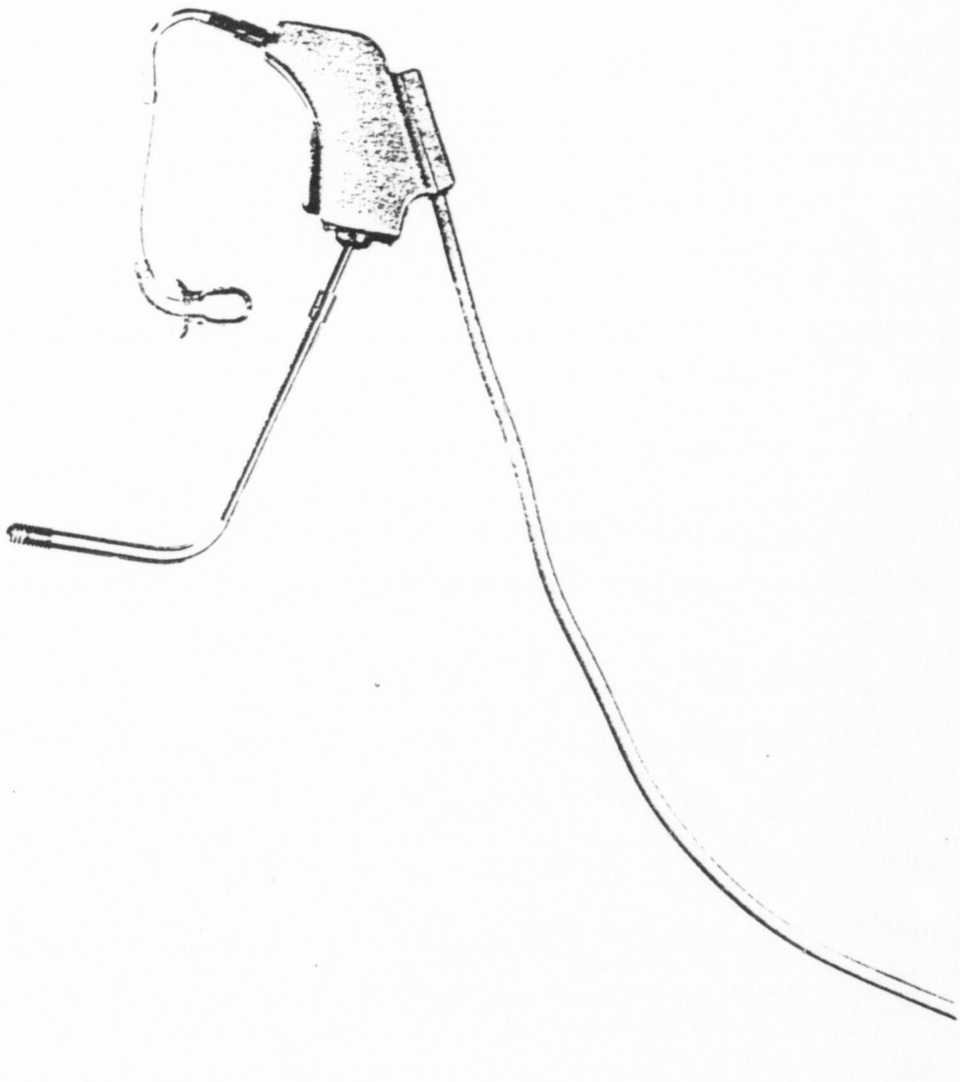


Ex. 4 (14)



Ex. 5 15

(3)

PLAINTIFF'S EXHIBIT 6

MWL FOLLOW UP

FU - 11W LEONHARDT 4-20-60 11-2-60

OPSFC - I. E. Sommermeyer

OPEDS - J. R. Cunningham
SFOED - F. E. Drake
SFOME - W. E. Rhoades

See photo's in P-0-24-14-4

June 30, 1960

File 0-0-24-14-4

Radio Aircraft Pilot's Microphones and Headphones.

The most widely used (but not necessarily popular) type of telephone headset is the World War II Military HS-33, or modifications thereof. (Such as the UAL 6F-2992). It is large, heavy, cumbersome, and uncomfortable to wear. The cords get entangled with airplane (and pilot) parts, and if the wearer happens to lean over, the set usually falls off his head. If one wears glasses, the large phones, pressing on the ears with glasses bows under them, are very uncomfortable. Trying to wear this type of headset over a cap is another unsatisfactory enterprise.

There are a variety of microphones for aircraft use, the majority being hand-held. The tendency is toward the differential dynamic type. Microphones also are relatively large, heavy, elusive, and awkward. Since there are becoming more and more things to occupy a crew member's hands, the hand-held mike has got to go.

Since the headphones and microphones are part of the plane equipment, and used by many, they are regarded by more than a few as being unsanitary.

In areas other than air transportation, there have been numerous attempts to develop lighter weight and more convenient headphones, such as the hearing aid type, and microphones such as the "boom" type, but never the two in satisfactory combination. Most of these developments still have many shortcomings. They are, for example, still awkward, and uncomfortable to wear.

We have heard you express the desire for improved pilot's headphones and microphone equipment, especially in the area of lighter weight and less cumbersome and less entangling devices. A step in this direction has been in the authorizing of the "Hearing Aid" type of earphone for pilot's use. While riding as O&O on our aircraft, especially the Jets, we have noted the increasing amount of radio communication that takes place, and the inconvenience, if not complete unsuitability, of our present equipment, in the subject area. Consequently, we are in complete sympathy with your desires, have been giving the subject considerable thought, and have an idea which may provide some of the answers. At least it is different than any so far proposed. It is intended primarily for Pilots, where a wheel

EP ~~005443~~ 005644

Ex. 6

(16)

button is available for microphone control. It could, however, also be used by the Second Officer, if he were provided with a foot or knee switch. Each crew member would have a set fitted and assigned to him. Any observers aboard can put up with the present equipment.

The proposed outfit would be built around, and supported by, a spectacles frame. The reason for selecting this basis is that most people are accustomed to wearing glasses and seem to be able to tolerate them for long periods of time. The idea is depicted in rough mock-up form in the attached photo No. 1. (So that you will not be distracted from the ensuing discussion, conjecturing about the identity of the subject in the attached pictures, we wish to state that he was merely an unidentified, but obliging itinerant.)

The simplicity and light weight of the mock-up is a goal, but probably will not be achievable in actual practice. For example, it may be necessary to build the pre-amp for the mike, into the glasses bows. In this event the bows would resemble those shown in photo no. 2, although probably not quite so large. The bow shown in this photo actually contains a microphone, transistorized amplifier, earphone, and battery, all in one bow! This will give to you some idea of the miniaturization possible with the modern techniques which we would employ in the development of this idea, should it meet with favor.

Some of the details of this concept are as follows:--

Lenses

The lens part of this assembly may be either prescription, colored, plain, or nothing.

Frames

The frames may be some the wearer already has or suits his fancy, or some standard stock item.

Bows

The bows are the special parts of this assembly. They contain, or support, all of the working parts and will be adjustable in length to fit the various users. At the moment, there are two thoughts on how the bows might be hooked to the ears. One is as depicted in Photo no. 1, except that the bows should curl further around the ears. The other is that the bows would not go over the ears at all, but instead they would curve down, to opposite the ear entrance, and terminate on the ear plugs themselves. In either case, the object is to rather firmly anchor the assembly in place, so that it will not be displaced askew by the activity of the crew member wearing same.

EP ~~054000~~ 005645

Ex. 6 cont.

17

Earphones

The earphones are of the "phonette" or hearing aid type, mounted on a short spring boom. They fit onto an ear plug. They do not snap into the plugs, but merely rest against them. The phonette booms are hinged to the bows, forward of the ear, so that either or both of the phonettes may be swung up (or down) out of the way in case the pilot wishes to engage in direct conversation or listen to the cockpit loudspeakers.

Microphone

The microphone is a very small differential dynamic element, supported by a lightweight adjustable loop. (Not necessarily resembling a mustache, as shown in the photo). The loop is hinged to the hinge end of the bows. The hinge is of a friction type, with two stops. One directly in front of the mouth, and the other swung up 180°, so the microphone is over the forehead.

Eye Shade

It seems that crew members are needing eye shades, more and more. For example, in viewing the Weather Radar Scope with the short hood, It is perhaps feasible, and desirable to extend a small individual eye shade from the top edge of each side of the glasses frame above the lens. (Not shown in the photo.)

Connector Cord

The connector cord will be either 4 or 5 conductor, depending on whether or not the mike pre-amp will need to be included in the assembly rather than having it part of the airplane. It is intended that the cord be very light in weight (hearing-aid type) and be of the "koil-cord" contruction with a total outside diameter of around 1/8". The wheel button would be used for microphone control.

The cord is terminated at the headset end in a very small plug, which may be plugged into either side of the headset, probably at the top of the bows, above the phonettes. (The photo gives only a very general idea of this feature.) The other end of the cord also terminates in a small plug, which plugs into a receptacle located above the pilot and slightly aft, outboard or inboard, but not directly above. This allows freedom of movement and keeps all cords out of the way.

Both plugs would have some kind of a latch to prevent inadvertent disengagement.

EP ~~005500~~ 005676

Wiring of the Assembly

The wiring of the headset itself would be contained entirely within the frame and bows. There would be no external inter-wiring to get broken or caught on something.

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Use with O_2 Mask

One of the goals to shoot at in this proposal is to eliminate the necessity for an extra mike in the oxygen mask. This goal probably will not be attainable. However, in any event, the only interference between this proposed headset and the oxygen mask would be from the mike boom, which can be swung up out of the way if necessary, and the O_2 mask mike used.

Stowage

It is intended that an outfit such as described above, would not be stowed in the aircraft, but instead, each pilot would be assigned his own individual set which would fold down like glasses and be kept in a case similar to, and very little larger than, a glasses case.

Cost

Now comes the hard part; it is estimated that it will take 2 or 3 years to develop this idea to the useable stage and cost around $20,000.00 for the development. The final product might list for as high as $300.00 each.

On the other side of the ledger, it is thought that there might be quite a demand for a successful development such as described above, and that therefor, it is probable that we could get back a substantial portion of our investment in royalties.

Please advise if you wish us to further pursue this concept.

WCM [illegible]
W. C. Mentzer - SFOEG

AFTtrumbull/sr

EP ~~005[illegible]~~ 005647

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EP 5648

20

EP5649

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PLAINTIFF'S EXHIBIT
Photo OF
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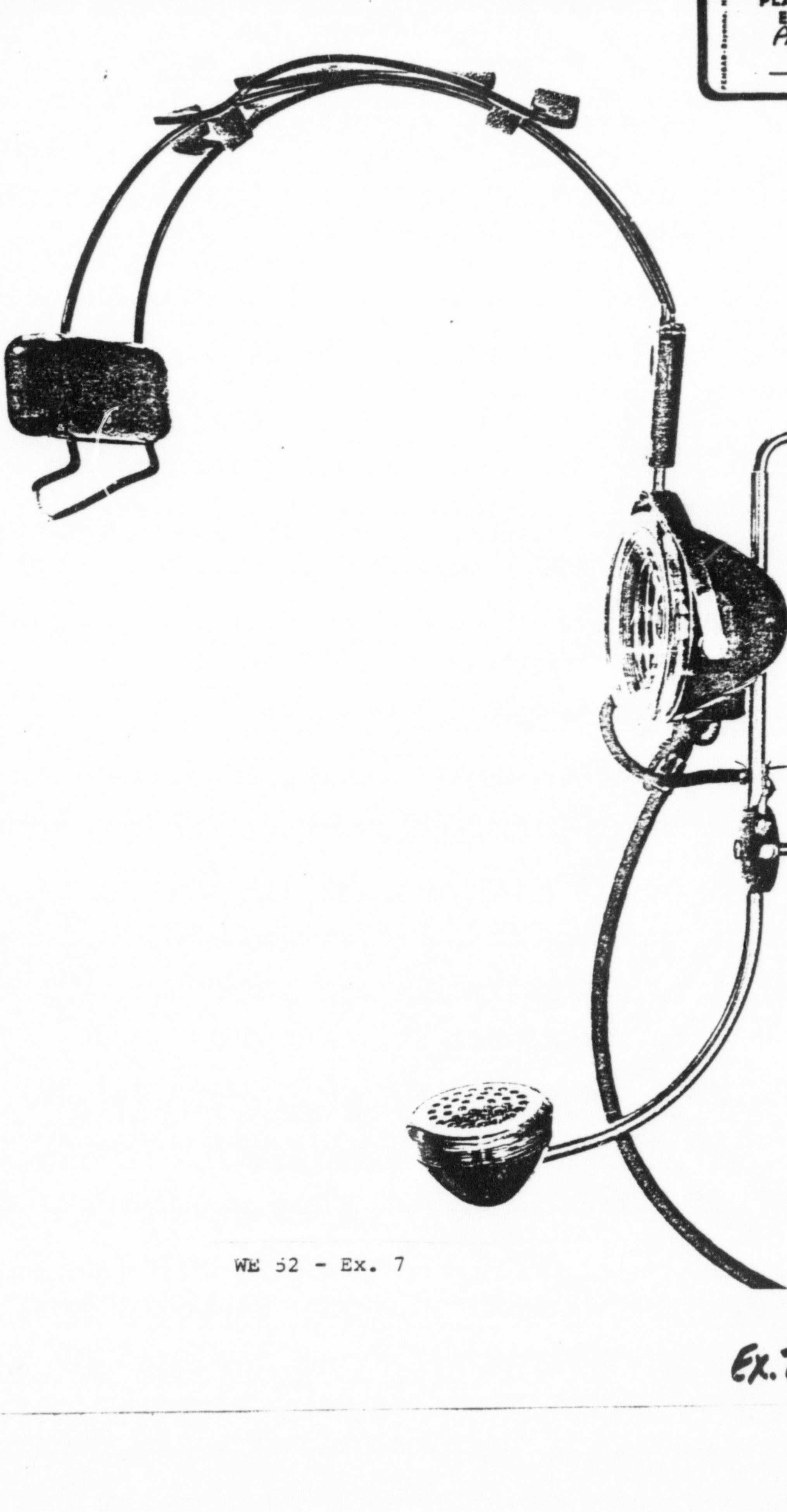

WE 52 - Ex. 7

Ex.7 22

COPY

PLAINTIFF'S EXHIBIT 8

SFOEG - W. C. Mentzer

SFOTD - F. E. Drake
SFOFE - W. E. Rhoades
OPBFO - I. E. Sommermeyer

OPBVC - J. M. Hodgson

August 17, 1960

WCM/JRC 6/30/60

04-C-0-24-14-3 Aircraft
Microphones -4 and Headphones

The subject of improved microphone/headset facilities for jet aircraft has been discussed at some length by Flight Operations, Communications, and SFOEG personnel.

There is general agreement that some type of boom mike, keyed by the wheel switch, would provide greater ease of operation. The reference letter submitted two novel approaches to the problem through the use of eyeglass frames for the support of the headphone/microphone unit. This solution, while having a great deal of merit, appears to be too far off for our urgent need. We recommend that this idea be pursued further for possible future application. In the meanwhile, we must move ahead promptly with a more conventional approach.

OPBVC has tried the Telex boom mike headphone set and inspected the telephone company 52A and 53A operators head telephone set. The 53A was completely ruled out due to lack of sufficient adjustment. While the 52A unit offers more flexibility, it leaves something to be desired. The Telex unit is flimsy and difficult to adjust.

It is requested that SFOEG review the market to determine what is available in the headphone/boom mike field and procure samples on consignment for evaluation by Flight Operations. The Airmed No. 5190 with the No. S.P.-2 mask assembly is to be included in the units obtained.

It may be that none of the available headphone/boom mike units will meet our requirements; in that event, it is requested that SFOEG try their hand again in a more conventional design. Design of such a unit should include a removable headphone unit to allow substitution of personal hearing aid type headphone.

J. M. H.

DLC:rp

Ex. 8

EP ~~005439~~ 005640

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COPY

PLAINTIFF'S EXHIBIT 9

OPSVC - J. M. Hodgson

SFOEG - W. C. Mentzer

CC: OPBFO - I. E. Sommermeyer

December 19, 1960

Subject: OL-C-0-24-14-3 & 4 - Headset/Boom Microphones.

Reference: JMH/WCM - 12/8/60

In lieu of answering the above referenced letter directly, it was felt that a complete status report on the above subject should be offered at this time.

Our initial inquiry (RFI #19741) was sent to 22 known vendors of headsets and microphones. Of these, 19 have replied so far. Twelve stated they could not meet our requirements for one reason or another. The balance of the vendors have complied as follows:

1. AIRMED, LTD. - Issued P/O for sample headset/boom microphone/oxygen mask. We expect arrival this week or next.

2. AMPLIVOX, LTD. - Received technical data and photographic brochures - equipment almost identical with AIRMED. Therefore, did not request sample.

3. CARTER ENGINEERING - Received sample assembly by personal delivery from IAI. Covered with consignment LPO. This unit given preliminary test and found to be very cheaply constructed. It was quite uncomfortable after one hour of wearing. This unit will be shipped to OPSVC with other units when they are received.

4. TELEX, INC. - They have offered a sample of a new development unit estimated to be completed in January 1961.

5. TELEPHONICS CORP - They advised of shipping a sample unit in October, but so far we have not received it.

6. ROANWELL CORP. - Sent brochures of available equipment, but without letter of transmittal or intentions. (During previous survey conducted by SFOEG regarding the S/O headset/boom, microphone desired by OPBFO, this company was quite aloof and difficult to negotiate with). Brochures did not disclose any new lightweight assemblies.

When the AIRMED assembly arrives and has been wired to the appropriate plugs, we will electrically test the unit prior to shipping to OPSVC for final evaluation. We will also send the Carter Engineering unit (and any others that are received) along with the AIRMED unit.

If you have further comments and/or recommendations, please advise.

WCM/AZ

SFOEG - W. C. Mentzer

H 12/19/60

H. Leonhardt/sr

Ex. 9 24

EP 6080.1

PLAINTIFF'S EXHIBIT
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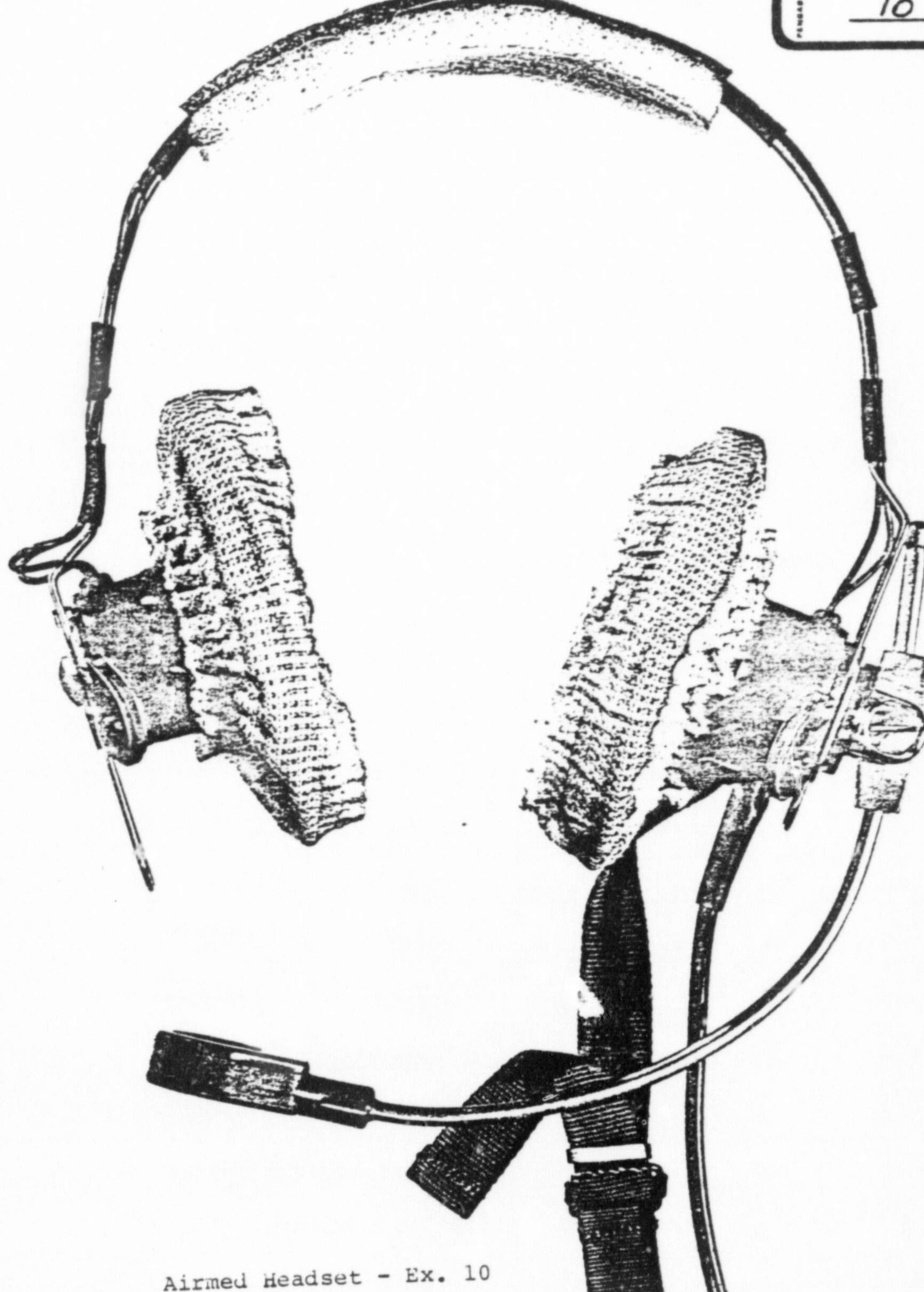


Airmed Headset - Ex. 10

Ex10 (25)

PLAINTIFF'S EXHIBIT 11

AMPLILITE AIRCREW HEADSETS SERIES A

AMPLILITE

Amplilite Headphones and Headsets, attractively finished in pale grey, combine lightweight wearing comfort with a robust construction. Designed for arduous service, all forms of the Headset meet the climatic and durability requirements of the Ministry of Aviation and Federal Aviation Agency.

Amplilite provides a standard of soundproofing only previously obtainable with Headset 13600 developed for R.A.F. Transport Command. Light alloy ear shells filled with sound-absorbing foam plastic and fitted with replaceable fluid-filled ear cushions protect the wearer from severe noise levels. Where high-noise attenuation is unnecessary, alternative soft rubber ear pads can be attached to the polythene-coated ear shells.

Any one of three microphones—standard magnetic, noise-cancelling magnetic or noise-cancelling carbon—may be attached to an all-position boom arm. A novel locking trigger on the boom permits full personal adjustment whilst allowing instant parking above the head when the microphone is not required.

Amplilite in a Bristol Britannia by courtesy of Cunard Eagle Airways

Amplivox Industrial

EP 006077

Note [illegible] at p. 20-21

Amplivox Brochure - Ex. 11

Ex. 11 26

AMPLILITE HEADSET

PERFORMANCE DATA

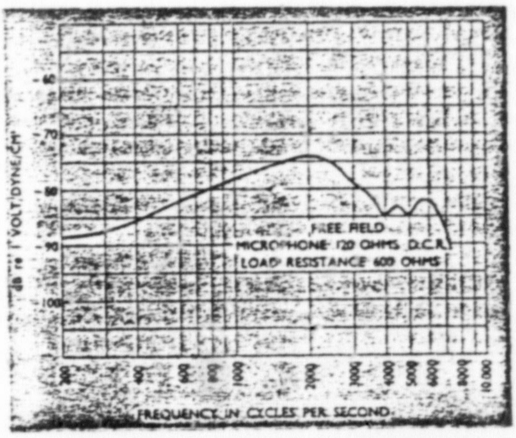
MICROPHONES

Standard Magnetic

Frequency Response
Rising smoothly at 5 dB per octave from 200 c/s to 2000 c/s, then falling at 10 dB per octave to 4000 c/s.

Sensitivity
For close speaking, the output is approximately 10mV.

Impedance
300 ohms at 1000 c/s.



Noise-Cancelling Magnetic

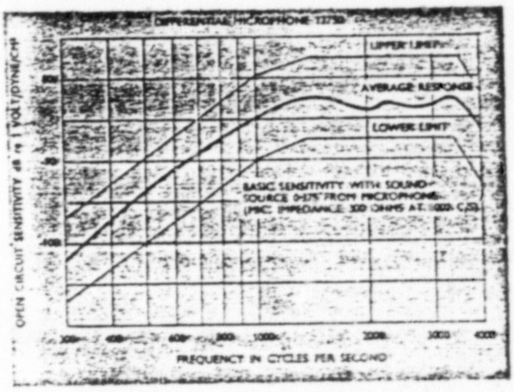
Frequency Response
Rising smoothly at 8 dB per octave from 300 c/s to 1500 c/s, then flat to 3500 c/s.

Sensitivity
The output is about 3 mV for speech close to the microphone.

Impedance
300 ohms at 1000 c/s.

Noise Cancellation

Frequency (c/s)	Effective Noise Cancellation (dB)
100	35
200	24
400	17
800	11
1600	6
3200	0



Noise Cancelling Carbon

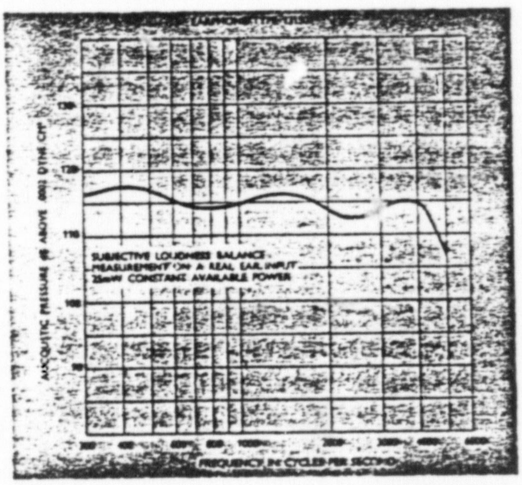
Frequency Response
Flat from 300 c/s to 4000 c/s.

Sensitivity
The output is approximately 20mV for close speech when polarised with 50mA d.c.

Impedance
100 ohms

Noise Cancellation
Minimum cancellation of 17dB.

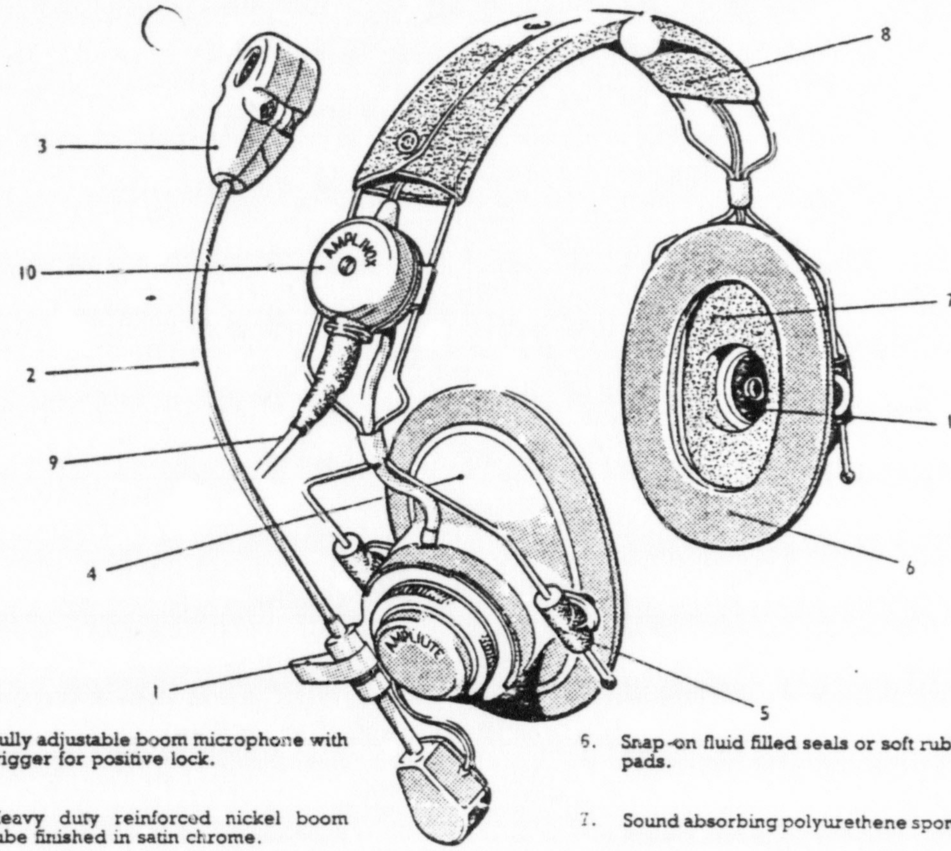
EARPHONE INSET (TROPICAL)



Frequency Response
Substantially flat from 300 c/s to 4000 c/s when mounted in a large earpad.

Sensitivity
An input of 25 mW will produce an acoustic sound pressure of the order of 115 dB in a large earpad of 28 cc. enclosed volume (see Graph).

Impedance
300 ohms at 1000 c/s, i.e., total headset impedance 150 or 600 ohms by parallel or series connection.



1. Fully adjustable boom microphone with trigger for positive lock.

2. Heavy duty reinforced nickel boom tube finished in satin chrome.

3. Choice of replaceable microphones:
   - Magnetic
   - Noise-Cancelling Magnetic
   - Noise-Cancelling Carbon

4. Light alloy ear shells coated with polythene.

5. Novel neoprene suspension for vertical adjustment and full articulation.

6. Snap-on fluid filled seals or soft rubber pads.

7. Sound absorbing polyurethene sponge.

8. Spring steel headband with replaceable plastic cover lined with foam rubber.

9. 6 ft. lightweight plastic cable.

10. Terminal block for easy replacement of cable and headband connector.

11. Fully tropicalised Miniature Magnetic Earphones.

OPTIONAL EXTRAS: Oxygen mask attachment points with counter support strap. . Adjustable coat clip.

ENCAPSULATED MICROPHONE AMPLIFIER

For use with equipment designed for carbon microphones, a resin encapsulated transistorised pre-amplifier weighing only half an ounce is available. This unit has passed Ministry of Aviation climatic and durability tests and is covered by Approval No. WR. 629. It will enable users of radio equipment with only carbon transmitter facilities to benefit from the high speech quality of magnetic and noise cancelling magnetic microphones. It is suitable for mounting within existing equipments or externally on a simple mounting bracket. The amplifier obtains its power from the carbon microphone energising supply.

Supply Voltage Range
5-21V d.c. (normal supply 15V; 13mA.)

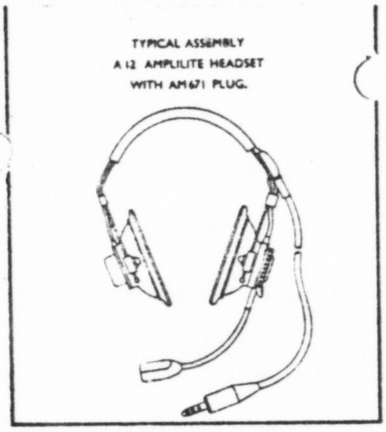
Voltage Gain
50dB (control set for 40dB).

Maximum Output
650mV into 100 ohms.

Frequency Range
250 c/s to 4000 c/s.

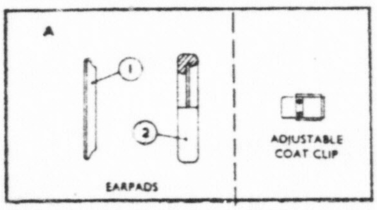
Dimensions
1½" × ¾" × 11/16" (3.8cm. 1.9cm. 1.7cm.)

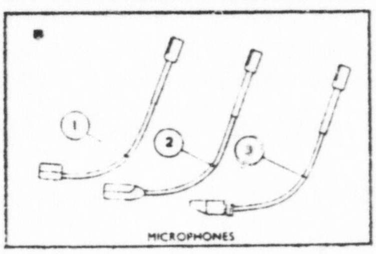
Fixing
Two mounting holes with 8BA screws .75" (1.905cm.) between centres are provided on one side of the amplifier.



ORDERING INFORMATION

PANEL REF.	ITEM NO.	DESCRIPTION	PART NO.
A	1	FLUID FILLED SEALS	16243
A	2	FOAM RUBBER EAR CUSHIONS	16230
B	1	MAGNETIC MICROPHONE	16201/1
B	2	NOISE CANCELLING MAGNETIC MICROPHONE	16202/1
B	3	NOISE CANCELLING CARBON MICROPHONE	16203/1





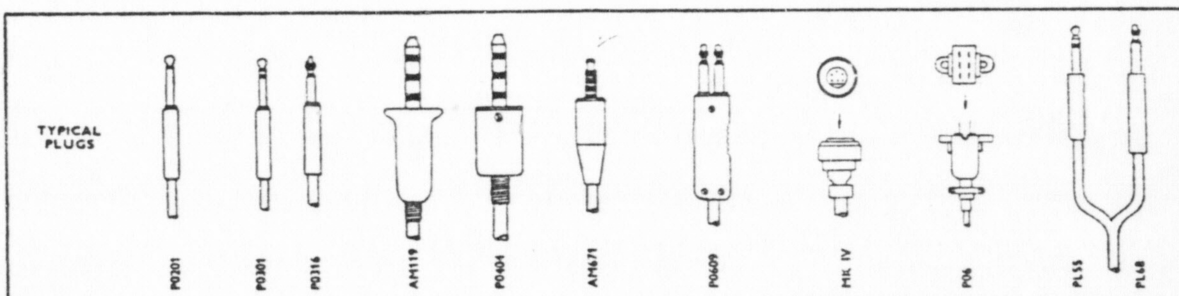
SERIES A

For Headsets specify Series A with numbers selected from Panels A and B in that order. State Type Number of preferred plug from the range illustrated and coat clip if required. Specify the microphone and headphone impedances if different from standard. The standard magnetic microphone impedance is 300 ohms and the standard headphone impedance either 150 ohms or 600 ohms; non-standard values may be supplied for an extra charge.

Example; Headset Type A.12 is supplied with solid wall ear shells, acoustic dampers and fluid filled ear cushions; the boom microphone is noise cancelling magnetic. The standard lead is a 6ft. 4-way plastic covered cable with two screened conductors and terminated by plug AM.671. The microphone boom is mounted on the left earshell as standard. The boom may easily be removed and reversed but headsets with right hand mounting can be supplied if specified.

IMPORTANT.—PLEASE STATE

Earphones;	Total impedance at plug.
Plug;	Type and terminal connections if different from those illustrated.



CONTACT	STANDARD CONNECTIONS									
	P0201	P0301, P0316	AM119, P0404	AM671	P0609		MK IV	P06	PL55	PL68
TIP. 1 OR A	TEL	MIC+ OR TEL	TEL	MIC+	L.H. TEL	R.H. MIC+	MIC+	TEL L.H.	TEL	MIC+
1ST RING. 2 OR B		TEL	MIC+	MIC	TEL	MIC	MIC	TEL L.H.		MIC
2ND RING. 3 OR C			MIC	TEL & SCREEN				SCREEN & TEL R.H.		
3RD RING. 4 OR D			TEL & SCREEN	TEL			TEL	TEL R.H.		
SLEEVE, 5 OR E	TEL	COMMON			SCREEN		TEL	MIC	TEL	SCREEN
6 OR F							SCREEN	MIC+		

AMPLIVOX LIMITED

INDUSTRIAL DIVISION

Beresford Avenue,
Wembley, Middlesex.
Telephone: WEMbley 8991
Telegrams and Cables; Amplivox, Wembley.

IH/2

Overseas; AMPLIVOX EXPORTS LTD.
Distributed by;—

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Printed in England

PLAINTIFF'S
EXHIBIT
Photo OF
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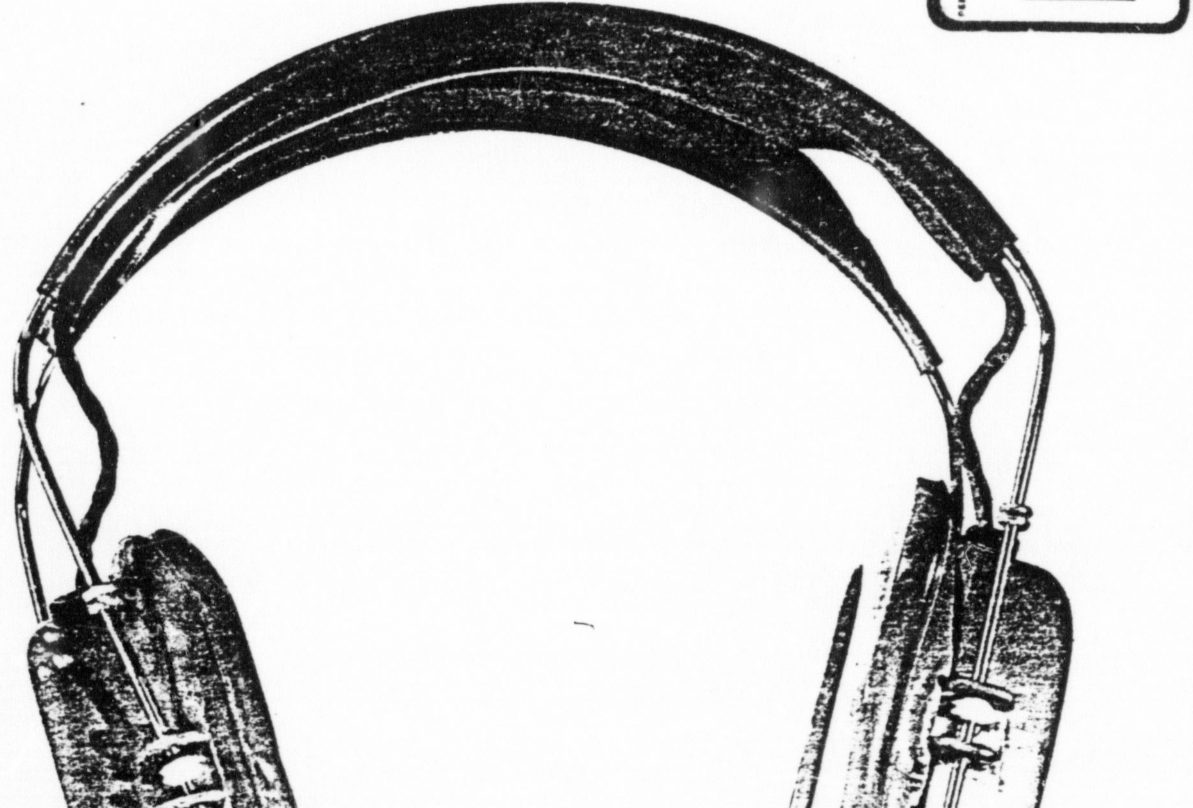

Carter Headset - Ex. 12

Ex. 12 30

PLAINTIFF'S EXHIBIT
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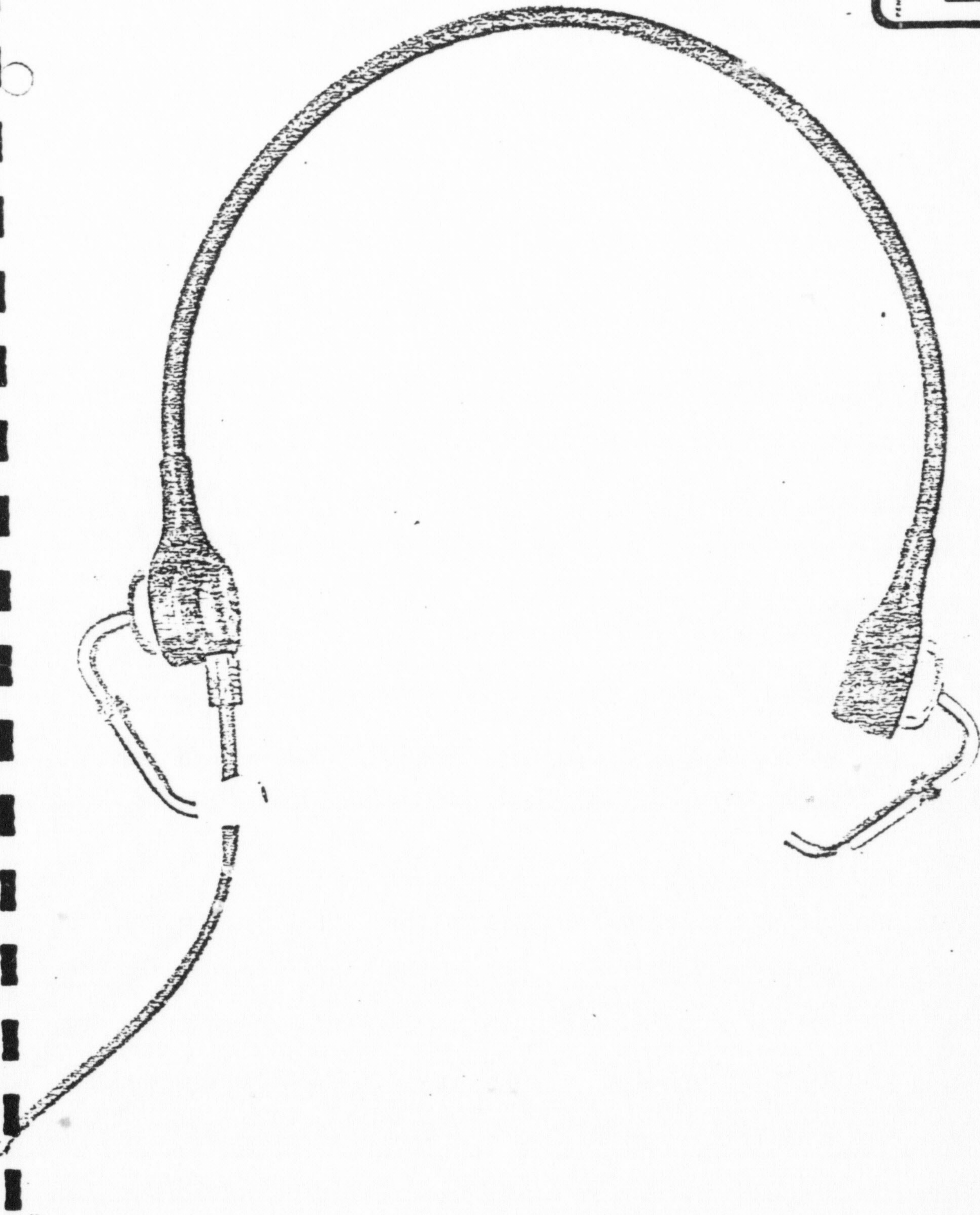

Ex. B 31

PLAINTIFF'S EXHIBIT 14

LIGHTWEIGHT HEADSET
AND
BOOM MICROPHONE

ARINC CHARACTERISTIC NO. 535
ISSUED MARCH 25, 1957

AERONAUTICAL RADIO, INC.

Ex. 14 32

EP 700

AERONAUTICAL RADIO, INC.
1700 K Street, NW.
Washington 6, D. C.

CHARACTERISTIC NO. 535

LIGHTWEIGHT HEADSET AND BOOM MICROPHONE

Issued: March 25, 1957

Prepared by the Airlines Electronic Engineering Committee

Approved by the Airlines Electronic Engineerin Committee:	October 18, 1956
Approved by the Board of Directors:	March 20, 1957
Approved by the Member Airlines:	March 25, 1957

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CHARACTERISTIC NO. 535.

Lightweight Headset and Boom Microphone

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FOREWORD

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Activities of Aeronautical Radio, Inc. (ARINC) and the Purpose of ARINC Characteristics

Aeronautical Radio, Inc., is a corporation in which the United States scheduled airlines are the principal stockholders. Other stockholders include a variety of other air transport companies, aircraft manufacturers and foreign flag airlines.

Activities of ARINC include the operation of an extensive system of domestic and overseas aeronautical land radio stations, the fulfillment of systems requirements to accomplish ground and airborne compatibility, the allocation and assignment of frequencies to meet those needs, the coordination incident to standard airborne communications and electronics systems, and the exchange of technical information. Through the Airlines Electronic Engineering Committee, composed of airline technical personnel, the standards for electronic equipment and systems for the airlines are formulated. The establishment of Equipment Characteristics is a principal function of this Committee.

An ARINC Equipment Characteristic is finalized after investigation and coordination with the airlines who have a requirement or anticipate a requirement, with other aircraft operators, with the military services having similar requirements, and with the equipment manufacturers. It is released as an ARINC Equipment Characteristic only when the interested airline companies are in general agreement. Such a release does not commit any airline or ARINC to purchase equipment so described nor does it establish or indicate recognition of the existence of an operational requirement for such equipment, nor does it constitute endorsement of any manufacturer's product designed or built to meet the Characteristic. An ARINC Characteristic has a two-fold purpose, which is:

(1) To indicate to prospective manufacturers of airline electronic equipment the considered opinion of the airline technical people, coordinated on an industry basis, concerning requisites of new equipment, and

(2) To channel new equipment designs in a direction which can result in the maximum possible standardization of those physical and electrical characteristics which affect interchangeability of equipment without seriously hampering engineering initiative.

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p. 6

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p. 7

CHARACTERISTIC NO. 535

Lightweight Headset and Boom Microphone

1.0 General Description

1.1 Function - This Characteristic covers the requirements for a lightweight headset with integral boom microphone suitable for pilot use with a conventional airborne radio installation. (There are some users who may desire the headset assembly described herein less the boom-mounted microphone.)

A number of different microphone and headset designs are in use in airline service and meet the users' requirements. This Characteristic is not intended to preclude other designs nor does it imply that this is the only satisfactory headset and microphone. It is also to be recognized that cockpit loudspeakers are widely used in airline service and that this Characteristic in no way reflects on their utility. This is simply a statement of characteristics which a number of air carriers feel constitutes a satisfactory design of a headset and boom microphone.

1.2 Associated Equipment - The headset will normally be used in conjunction with a conventional isolation amplifier. The microphone will use a transistor pre-amplifier to be located at or near the microphone jack to raise the voice level to a value equivalent to carbon microphone output.

1.3 Applicable Publications, Specifications and Drawings -

(a) ARINC Report No. 403, "Guidance for Designers of Airborne Electronic Equipment," issued September 1, 1955.

(b) ARINC Report No. 306, "Guidance for Designers of Airborne Electronic Installations," issued September 1, 1955.

* (c) RTCA Paper 100-45/DO-60, "Environmental Test Procedures - Airborne Radio Equipment," dated April 13, 1954.

* This RTCA report is not available from ARINC, but can be obtained from the Radio Technical Commission for Aeronautics, Building T-5, Room 2036, Sixteenth and Constitution Ave., Washington 25, D. C. Telephone STerling 3-8984.

1.4 Regulatory Approval - To insure provisions for approval of the device, manufacturers should note the usual environmental test requirements outlined in the document referenced in Section 1.3 (c). All applicable CAA Type-Certificate or TSO requirements should be met.

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p.8

2.0 Mechanical Considerations

2.1 Weight - The unit should weigh not more than seven ounces. This weight is to include headset and microphone but does not include cable and plug.

2.2 Ear Pieces - The ear pieces should be designed to provide efficient sound coupling without discomfort to the user when worn for extended periods of time. Large sponge rubber caps are not considered suitable. If insertion-type ear pieces are used, they must be easily replaceable and should be attached in such a manner that accidental removal will be unlikely.

2.3 Boom Microphone - The boom should be adjustable to the extent of movement toward or away from the user's face. It should also be pivoted at or near the earpiece so that it may be swung upward out of the way. The locking device on this action should be of a type that will allow the swing-up or swing-down to be made quickly and freely but should provide a positive lock at the up and down positions.

The microphone design should be such as to permit using some form of replaceable vapor shield.

2.4 Cord - The single four-conductor cord should be lightweight type rubber- or plastic-covered for abrasion resistance and cleaning ease. The nominal length should be five feet.

3.0 Electrical Characteristics

3.1 Microphone - The microphone should be of the differential or noise-cancelling dynamic type. Microphone output impedance should be 30 to 50 ohms. The frequency response of the microphone should be flat within plus or minus 3 db from 300 cps to 6000 cps.

Note: The microphone output should be such that when used in conjunction with a transistor pre-amplifier the output level will be of a value equivalent to carbon microphone output. The specific figure for output level will be determined upon later advice from the manufacturers.

3.2 Headset - The headset should have an input impedance of approximately 500 ohms.

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3.0 Electrical Characteristics (Continued)

3.3 Plug - A single plug and cord should be provided for the microphone and headset. The plug type should be a Cannon XLR-4-12C straight plug with the following pin connections:

Pin 1 -- Headset
Pin 2 -- Headset
Pin 3 -- Mike - high
Pin 4 -- Mike - return

Note: While the above plug is preferred as the industry standard, there may be a need by some carriers for retrofit aircraft and some other uses, to continue utilizing the commercial equivalents of the PL-55 and PL-68 plugs. For these circumstances, the mike and headset should be available with a single cord, branched approximately 6" from the connector end and the pin connections should be as follows:

Headset - PL-55 standard connections
Mike - PL-68 standard connections:
Mike - Connected between tip and ring
Shield Ground - Connected to sleeve

3.4 Interaction - Interaction between the microphone and headset in the cord should be held to a minimum by suitable shielding techniques.

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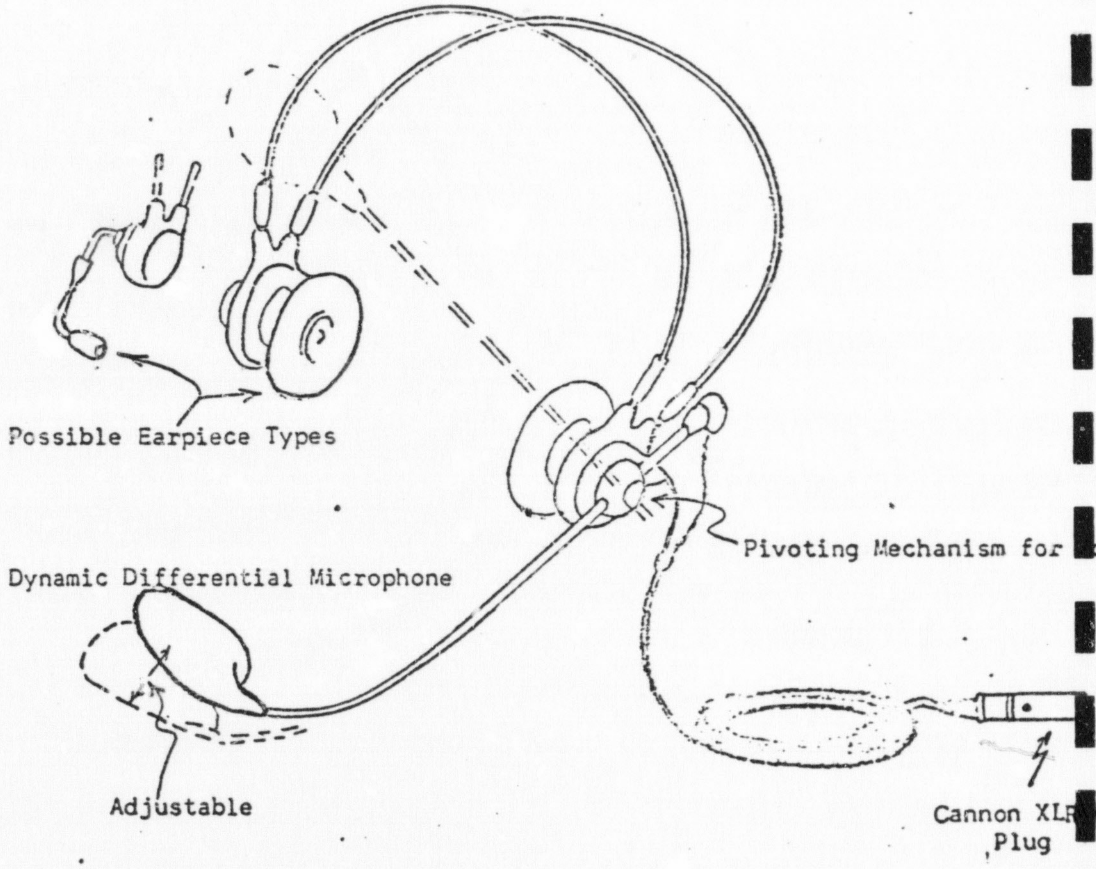
p. 10

ATTACHMENT I



One Possible Arrangement for
Light-Weight Headset and Boom
Microphone

Sketch Based on
PAA Drawing 707-1

ARINC Spec. - Ex. 14

#2
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p. 11

March 25, 1957

LIST OF ARINC DOCUMENTS

Number	Title	Issued	Revisions	Price (Non-Members)
Report 304	Electronic Installation Guidance Material	8-1-53		n/c
Report 306	Guidance for Designers of Aircraft Electronic Installations	9-1-55	Reprinted 12-20-55	$1.00
Spec. 401	Crystal Unit Specification	11-20-52	Revised 4-10-54	n/c
Report 402A	Preferred List of Special Quality Tubes	7-8-55	2d Printing Apr.'56	n/c
Report 403	Guidance for Designers of Airborne Electronic Equipment	9-1-55	2d Printing 12-31-56	$1.00
Spec. 404	Air Transport Equipment Cases and Racking	5-1-56	2d Printing (Incl. Suppl.1 dated 5-1-56) 6-1-56	$1.00
**Report 405	ADF Antenna Requirements for the Commercial Airlines	11-10-55		$1.00
Report 406	Airborne Electronic Equipment Standardized Interconnections & Index Pin Codes(Pinform Report)	10-12-56		n/c
	Supplement 1 to Report 406	1-15-57		n/c
	Supplement 2 to Report 406	3-25-57		n/c
*Char. 519	Airborne Glide Slope Receiving System	3-8-50	Revised 4-30-52	n/c
			2d Printing 10-25-56	n/c
Char. 520A	Airborne VHF Communications System	6-28-54		n/c
*Char. 521	Airborne Distance Measuring Equipment	12-10-51	(Now Obsolete)(Out of Print)	
Char. 521B	Airborne Distance Measuring Equipment TACAN (DMET)	3-25-57		n/c
*Char. 522	Airborne HF Communications Transmitter	3-21-52	2d Printing (Incl. Suppl. 1 dated 9-5-52) 9-10-54	n/c
*Char. 523	Airborne HF Communications Transmitter Power Unit	3-21-52	2d Printing 9-10-54	n/c
*Char. 524	Airborne HF Communications Selector System	3-21-52	2d Printing 9-10-54	n/c
*Char. 525	Airborne HF Communications Antenna Tuning Unit	3-21-52	2d Printing (With minor changes): 9-10-54	n/c
*Char. 526	Airborne HF Communications 144-240 Channel Receiver	3-21-52	3d Printing 4-20-56	n/c
*Char. 527	Airborne HF Communications Multi-Frequency Receiver (Tentative)	3-21-52	2d Printing (With minor changes): 9-10-54	n/c
*Char. 528	Airborne Tape Reproducer	1-10-52	Revised 9-10-52	
*Char. 529	5.7 cm. Weather Penetration Radar	6-28-54	2d Printing (Incl. Suppls.1 & 2): 1-8-57	n/c
Char 530A	Airborne ADF System	4-2-56		n/c
Char. 531	Airborne Selective Calling Unit	6-28-54	2d Printing 5-25-56	n/c
Char. 532A	Air Traffic Control Transponder	4-2-56	Revised 3-25-57	n/c
Char. 534	VHF Emergency Transceiver	3-25-57		n/c
Char. 535	Lightweight Headset and Boom Microphone	3-25-57		n/c
Char. 538	Hand-Held Microphone	3-25-57		
**	ARINC Synchro System Manual		1st Printing Nov. 1950 4th Printing Jan. 1954	$3.00

* Note 1: This document for reference use only. Will no longer be maintained current. Contact ARINC for any specific information required.

Note 2: ARINC Characteristics, Specifications and Reports are prepared as a service for ARINC member companies, special subscribers and those cooperating in committee work. Such reports are distributed to the ARINC membership at no charge. Copies of most of the earlier documents listed above are still available upon request.

** Note 3: Because of the higher printing cost for these documents, this price also applies to additional copies requested by members.

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EXHIBIT

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Subsequent corr. on 6-00-23-52

April 17, 1961

In reply, please refer to our file No.: 08-0-0-24-14-4

Plane-Aids Company
P. O. Box 801
Soquel, California

Gentlemen:

It has come to our attention that you are agents for a Japanese product that incorporates a Broadcast Radio Receiver in a pair of sun-glasses.

While we are not interested in this product as such, we are interested in another possible application of some of the techniques involved.

If you are in this area sometime, and are interested, drop in and we will discuss the subject. Ask for Mr. A. F. Truxall in Radio Engineering.

Yours very truly,

UNITED AIR LINES, INC.

W. C. M. [illegible]

W. C. Mentzer,
Vice President
Engineering

AFT/cr

Note

Keith Larkin phoned for an appointment, and then visited us ([illegible]) on 4-25-61. We told him that the reason for the inquiry was that we were looking for someone interested in developing a real small light weight headset/[illegible] [illegible]. Keith will [illegible] [illegible] [illegible]. We discussed all factors involved. Keith will [illegible] and give us a proposal. Told Keith that there was no [illegible] [illegible] in this development, in UAL, so he could not count on any financial help from UAL, nor any orders, even if he did come up with something. Conversely, if he did come up with something, it would be his, and UAL would have no claim to it.

[illegible] 4-25-61

PLANE-AIDS COMPANY

Design · Development · Distribution of Specialized Aircraft Components

GREENWOOD 5-7070

POST OFFICE BOX 801
SOQUEL, CALIFORNIA

EP 5641

005405 0U5641

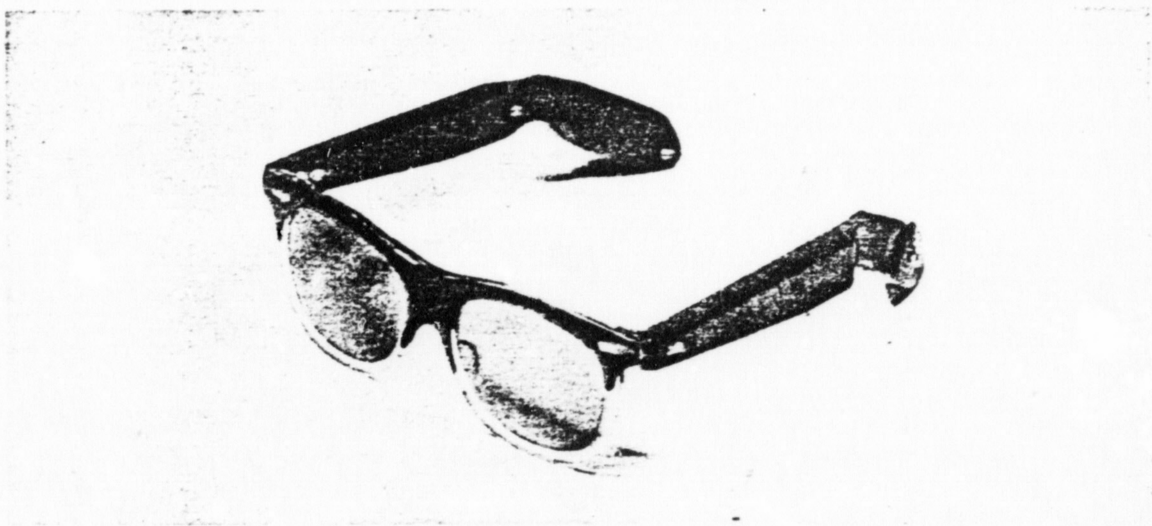
(700+)
(7005)

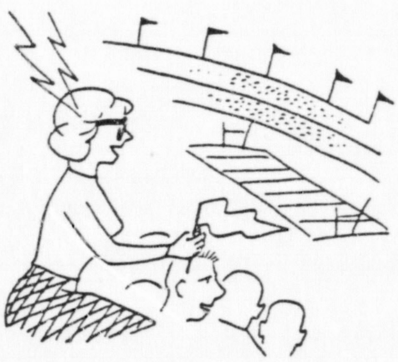
Ex. 15 (44)

PLAINTIFF'S EXHIBIT 16

PLANE-AIDS' NEW

Sun & Fun Glasses





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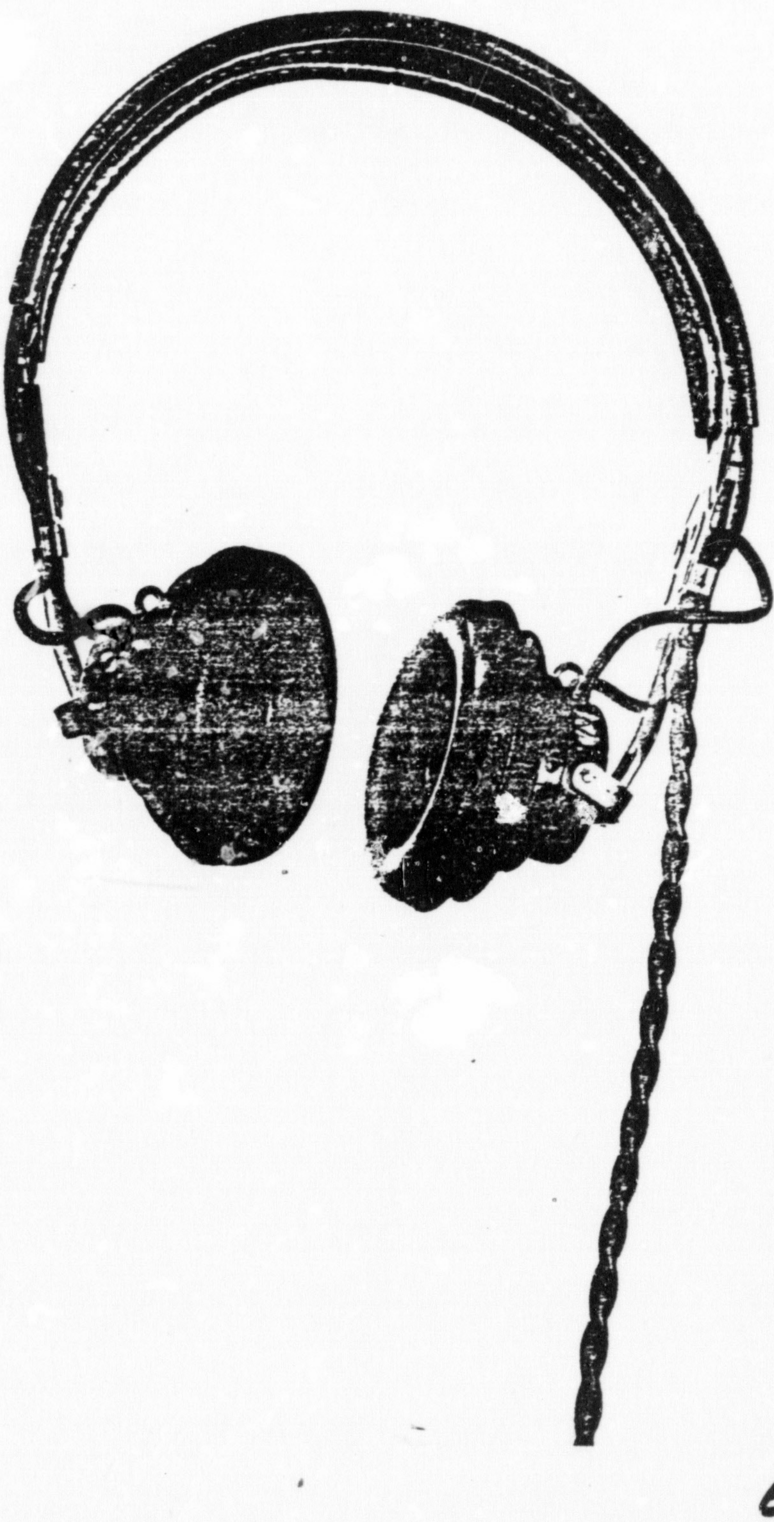

Ex. 17 45

PENGAD-Bayonne, N.J.
PLAINTIFF'S
EXHIBIT
Photo OF
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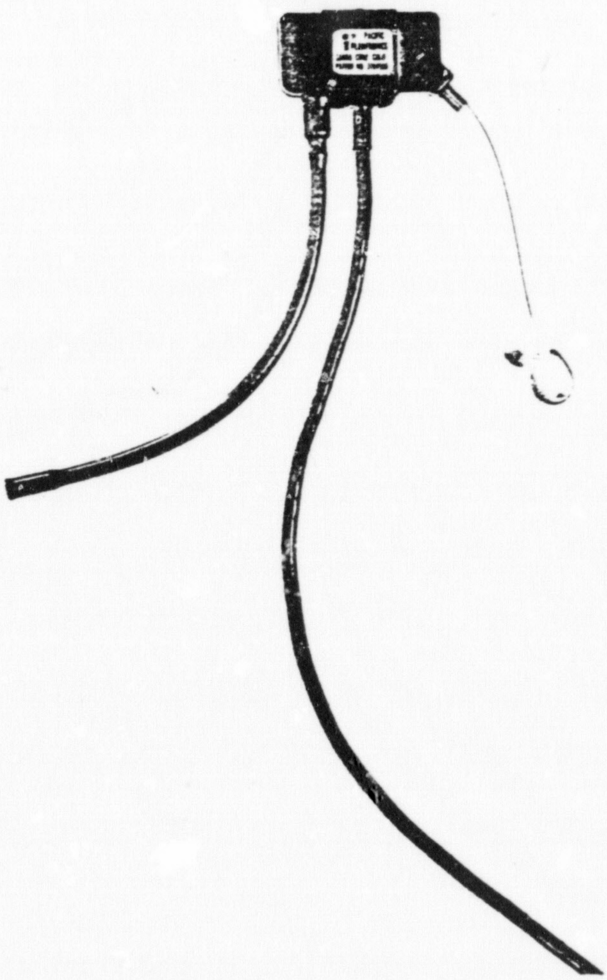

Ex. 18 (46)

NASA
S-69-39534

EXHIBIT 19

EP 10,749

Ex. 19 (47)

EXHIBIT
20

Powers Copy 15.

Larkin Exhibit #37
11-7-73 MM

ANALYSIS OF PLANTRONICS HEADSET

Requested by Mr. V.L. Carbonaro

Tests Conducted at Roanwell Corporation, Accustics Laboratory

Data Obtained: L. A. Morrison
P. Beiser
P. Bowens
M. D'Agostino
R. Danielson

Tests Completed: November 8, 1962

F322271

Ex. 20 48

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F [illegible]

PLANTRONICS HEADSET MODEL MS-50

Much interest has been generated in this headset in the past few months. Among the reasons that have come to our attention are:

1. Commercial airlines pilots have been purchasing these headsets with their own money, and using them instead of the equipment they have been issued.
2. F.A.A has been purchasing these headsets for some of their applications.
3. A modification of this headset was used by Project Mercury astronaut, Walter Shirra in his recent orbital flight.

A series of tests were devised to enable us to evaluate this headset, and permit us to compare its functions and acoustical characteristics to the conventional headsets we are presently manufacturing.

HEADSET:

The first, and most important test was the talkout test. The MS-50 was connected through appropriate amplifiers to an H-157 type headset. I believe most of the readers had the opportunity to evaluate the talkout of the MS-50. All of the comments which I heard, were certainly favorable. The only complaint that I remember hearing was that the earplug was discolored, this discoloration gave the earplug a very unpleasant appearance.

MICROPHONE:

Frequency response tests were conducted using the Air Force type loading tube. The frequency response characteristic and the power output of the MS-50 microphone is somewhat similar to that of an M-33 type microphone (Data given on Page 3).

In listening to the microphone during talkout it seemed to have little or no noise-cancellation. This was corroborated by a comparison of frequency response, close sound source (Page 3) and frequency response, distant sound source (Page 6). Comparison showed virtually no difference between the two curves, indicating no measurable (for this test method) noise-cancellation for the MS-50 microphone.

No acoustical data was taken on the microphone with the oxygen mask adapter. However, the adapter was tested during talkout. Adding the adapter to the microphone tube caused a definite decrease of low frequency transmission. This would seem to be desirable in an oxygen mask because of the low frequency reverberation or boominess which is inherent when sound is produced in the mask.

EARPHONE:

The frequency response, sensitivity and impedance of the MS-50 earphone were tested as described on Page 2.

The frequency response curve of the earphone with its tube and earplug are not as flat as the curves we are used to seeing. However most of the dips and peaks are introduced by the tube and earplug. This is shown very clearly in Mr. Morrison's data on Page 8.

The sensitivity of the earphone, when measured at 1000 cps, is higher than that of an H-143 type receiver, but because of the predominant peak near the 1000 cps point the sensitivity reading will not give a true indication of the overall loudness of the earphone.

There is an appreciable difference in efficiency between the system using an H-143 earphone in a large cavity earcup and the system using the MS-50 earphone with its tube and earplug (small cavity). This difference becomes apparent when comparing the power required by each system to produce adequate sound level to the ear, or the test microphone. The H-143 type requires 1 milliwatt of power, whereas the MS-50 (hearing aid type) requires .1 milliwatts of power.

Overall harmonic distortion was checked with .1 milliwatts available to the MS-50 earphone; results are given on Page 10. The percentage distortion recorded is appreciably higher than would be found in an H-143 type receiver.

The super-imposed D.C characteristic taken by Mr. Morrison (Page 9) indicates that this unit is magnetically imbalanced. This imbalance could be intentional if the earphone was designed to operate with a D.C bias. If not intentional it would indicate that some of the assembly operations may be somewhat critical.

Sketches of the Plantronics capsule and the earphone element, (in various stages of disassembly) will be found on Pages 11 through 14.

TRANSISTOR AMPLIFIER:

The MS-50 trans-amp was tested in the circuit prescribed by the manufacturer (Page 16). Under these conditions the MS-50 microphone amplifier system is capable of power output approximately 8.5 db higher than that of an M-6 carbon transmitter. Mr. Marchand has indicated that the temperature range in which this amplifier can be operated is limited. This would restrict the acceptance of the unit by the services.

COMMENTS:

The Plantronics MS-50 headset microphone may well be one of the first of a new generation of headsets. In reviewing the technical data alone one would find little that was unique in the MS-50. I suspect that someone technically involved with acoustics who knew nothing of the units sale acceptance would not think too highly of it, based on its technical data alone.

It seems that Plantronics has come up with a combination of user comfort, low weight, high versatility, and adequate voice transmission which has gained them appreciable acceptance (Project Mercury) in a relatively short time.

The MS-50 is certainly not the perfect headset. It has two very apparent shortcomings for military applications. One, the lack of noise-cancellation and two, the temperature range of the amplifier.

Indications are that the people at Plantronics are competent individuals with a good knowledge of merchandising and practical application of headsets and microphones from the users point of view. If this is so, they may well be working on revisions or modifications to their present unit which would eliminate the above mentioned disadvantage.

F [illegible]

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EXHIBIT
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ROANWELL
CORPORATION
INTER-OFFICE COMMUNICATION

FOR
FOLLOW UP

S. D. MADDOCK DATE DECEMBER 7, 1962

FROM D. W. POWERS SUBJECT PLANTRONICS, INC.

I discussed our interest in the Plantronics headset with Mr. Howell today. We both feel that this may be the basis of a new generation of headsets or headset-microphones. We are therefore interested in determining what kind of a deal could be made with Plantronics for the purchase of this headset as a going business. We would expect to take over all designs, drawings, tools, inventory, open orders, etc., and manufacture, sell and service the product from our present plant at 180 Varick Street.

Will you please let me know whether or not you will follow up this matter with the principals of Plantronics or if you wish to have me write to them direct.

D. W. Powers

P/hw
cc: R. W. Howell

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Ex 21 52

JUL X X 1972

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

EXHIBIT
22

CERTIFICATE OF TRUE COPY

I HEREBY CERTIFY that the attached { is a true copy / ~~are true copies~~ } of the original

Memorandum Report, Development of Lightweight Headset, Project No. 111-16D, dated February 1963, on file in the Commnications Division, Systems Research and Development Service, Federal Aviation Administration, Washington, D. C. 20591.

Signed and dated at Washington, D. C.

this 11th day of June, 1973

by Robert W. Meier

Chief, Communications Division
(Title)

* *

I HEREBY CERTIFY that Robert W. Meier

who signed the foregoing certificate is now, and was, at the time of signing Chief, Communications Division, Systems Research and Development Service, Federal Aviation Administration

and that full faith and credit should be given his certificate as such.

IN WITNESS WHEREOF, I have hereunto subscribed my name and caused the seal of the ~~Federal Aviation~~ Department of Transportation ~~Administration~~ to be affixed this 12th day of June, 1973 at Washington, D. C.

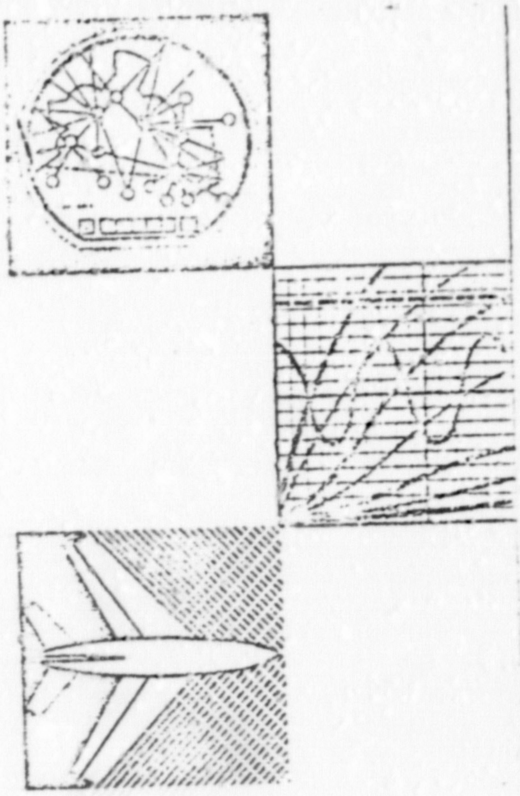
Warren F. Ellinger
(Signature)

for Chief, Program Management Staff
(Title)

Systems Research and Development Service
(Organization of the Federal Aviation Administration)

FAA Form 2716 (1-67)

Ex. 22 53



MEMORANDUM REPORT
Project No. 111-16D

DEVELOPMENT OF LIGHTWEIGHT HEADSET

[illegible] has been approved for general [illegible]

February 1963

FEDERAL AVIATION AGENCY
Systems Research & Development Service
Development Division
Washington, D.C.

(54)

MEMORANDUM REPORT

Project No. 111-16D

DEVELOPMENT OF LIGHTWEIGHT HEADSET

February 1963

Systems Research & Development Service

FEDERAL AVIATION AGENCY

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MEMORANDUM REPORT

DEVELOPMENT OF LIGHTWEIGHT HEADSET

PROJECT 111-16D

Prepared by:

G. V. Rodgers

G. V. Rodgers
Chief, Systems Modernization Section

Approved by:

Robert W. Meier

R. W. Meier
Chief, Communications Branch

Released by:

W. E. Jackson

W. E. Jackson
Chief, Development Division

February 1963

FEDERAL AVIATION AGENCY
Systems Research and Development Service
Development Division
Washington, D. C.

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Development Division, Systems Research and Development Service,
Federal Aviation Agency, Washington, D. C.
DEVELOPMENT OF LIGHTWEIGHT HEADSET by G. V. Rodgers
February 1963, Memorandum Report, 46 pp. incl. 13 illus. and
3 Appendixes (Project No. 111-16D)

ABSTRACT

An extremely compact and lightweight headset was developed for air traffic control use by Pacific Plantronics, Incorporated, Santa Cruz, California. The microphone and receiver elements are contained in a small capsule with plastic tubes extending toward the mouth and ear. The capsule may be worn on a lightweight headband or clipped to the frame of a pair of eyeglasses.

Trials were conducted at the Oakland Air Route Traffic Control Center to determine the relative merits of the Plantronics headset in comparison with the headset normally used and with a new headset furnished by Bell Telephone Laboratories. The results showed the Plantronics headset to be superior to the other headsets and preferred by a majority of air traffic controllers.

The Problem

For many years the Agency has sought an improved headset which could be worn by controllers for long periods of time without discomfort and yet provide adequate transmission and reception capabilities. The headsets normally issued have been described by the controllers as bulky, heavy, uncomfortable, and cumbersome. They have been known to produce headaches and sore ears after continuous wear, and have caused interference with normal activities such as eating and smoking.

Development Effort

Numerous attempts have been made to provide improved headsets both by requests to the telephone companies and by investigation of commercially available items for possible use by air traffic controllers.

Several commercially available items have appeared promising and have been privately purchased and tried with some favor. Foremost of these were the Telex headsets and various hearing aid receivers which employed earpieces to fit inside the ear, thereby eliminating the earcups and pads which were a major cause of discomfort. Minor modifications were made to the currently used Western Electric Type 52 headset from time to time, but there were no major improvements.

A number of the most promising commercially available items were purchased and sent to the National Aviation Facilities Experimental Center for tests of their acoustical characteristics. The plan was to determine the most suitable transducer elements for transmitting and receiving and to develop an improved headset using these elements as a basis.

In September, 1961, representatives from Pacific Plantronics, Incorporated, came in with an idea and a proposal. The headset which they proposed to develop appeared so ideally suited for air traffic control use that the previously planned in-house development effort was discontinued. Pilot models of the Plantronics headset were procured for laboratory and environmental testing. Since the microphone was required to operate into telephone circuits, Plantronics was asked to develop a transistorized amplifier which would duplicate the carbon microphone in output level and impedance. Modifications and improvements of the headset were made from time to time during the development period based on the results of initial tests in an operational environment.

The Plantronics MS-50 Headset

The Plantronics MS-50 headset is shown in Figure 1. The unit may be worn with the headband, as shown in Figure 2, or clipped to a pair

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of eyeglasses, as shown in Figure 3. The complete headset with headband weighs less than two (2) ounces. The headset may be used in a number of wiring arrangements; however, the configuration for air traffic control use includes a handswitch capsule with a coiled expansion cord and connecting plug.

The transmitting and receiving elements are miniature moving vane dynamic transducers which are shielded with mu metal, shock mounted in rubber and sealed in a metal case. The acoustical transmitting tube is composed of a synthetic material which returns to its original shape after bending. The tube is reversible for right or left side use. The earpiece is composed of a soft plastic material and is available in a number of sizes to fit properly into the smallest to the largest human ear openings. The earpiece is vented to prevent pressure build-up and is impregnated with an antiseptic to discourage infection.

A shielded lightweight cable connects the transducers to the handswitch capsule. This cable was developed especially for the application and will withstand 2,000,000 cycles of flexing at 110 degrees of bend before failure.

The handswitch capsule is of the same size and shape as that supplied with the Western Electric Type 52-B headset; however, in addition to the switch, the capsule for the MS-50 headset also contains a three-stage transistor amplifier. The amplifier is designed to provide the same signal level and output impedance as the carbon microphone of the Type 52 headset and derives its power from the supply which normally provides polarizing current for the carbon microphone. A diode bridge arrangement allows the amplifier to operate regardless of the polarity of the power supply.

Two plug and switching arrangements, a four-wire, and six-wire version, were procured. The four-wire version was designed for telephone installations in which the transmitter is keyed by means of a relay in series with microphone signal line. The six-wire version was designed for use with Bell 300 System in which a separate pair of wires are used for transmitter keying. A double, two-connector (tip and sleeve type), telephone jack plug is used with the four-wire headset; a double, three-connector (tip, ring, and sleeve type), telephone plug is used with the six-wire headset. The coiled cords and plugs presently used are standard telephone company items.

Laboratory Tests

Frequency response and distortion tests were made by the contractor to provide assurance that the MS-50 headset was capable of performance

equal to that of the Western Electric 52-AW headset which is essentially the same as the 52-B, the currently used version of the Type 52.

The frequency response characteristics of the 52-AW and the MS-50 transmitters are shown in Fiugres 4 and 5 respectively. Based on the commonly used ± 6 db criteria for determining frequency response, the high frequency response of both units was approximately 4500 cps. The low frequency response of the MS-50 was 350 cps while the low frequency response of the 52-AW was 30 cps. Since frequency components below approximately 300 cps add very little to the intelligibility of speech and may contribute objectional noise, the MS-50 low frequency response was considered preferable for communication purposes.

The frequency response characteristics of the 52-AW and MS-50 receivers are shown in Figures 6 and 7, respectively. These curves show that the MS-50 receiver response compares favorably with that of the 52-AW. The receiver port in the MS-50 provides a low frequency rolloff which starts at 200 cps and provides 20 db attenuation at 60 cps over the unported receiver.

The relative distortion of the MS-50 and the 52-AW transmitters was observed by viewing the waveform of normal voice conversation on an oscilloscope. The response of the carbon microphone is shown in Figure 8. It was noted that the modulation envelope was non-symmetrical about the base line. This type of distortion was not present when using the MS-50 microphone as shown in Fiugre 9.

The microphone of the Type 52 headset is placed in front of the user's mouth and is, therefore, susceptable to breath and wind noises which do not add to the intelligibility of speech. Figure 10 shows the response to the wind noise and sibilants when the word "succotash" was spoken. The voice tube of the MS-50 is located at the corner of the mouth away from the direct wind region. Figure 11 shows the MS-50 response to the same word. It was noted that the carbon microphone of the Western Electric 52 headset produced noise with movement of the head as shown in Figure 12. This effect was not present when the dynamic microphone of the MS-50 was used as shown in Figure 13.

The output of the Type 52-AW microphone was shown to change considerably with excitation current. When the current was changed from 120 ma to 60 ma the response at 1000 cps changed 11 db. The MS-50 response changed less than 3 db for the same supply current variation.

<u>The Oakland Trials</u>

Subjective trials were conducted at the Oakland ARTCC in Fremont, California, to determine the relative merits of the MS-50 headset

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as compared with the Model 52-B. Bell Telephone Laboratories also supplied a new headset, the Type Y-1 for comparative evaluation.

The Y-1 was somewhat lighter in weight than the 52-B and was designed for a minimum amount of adjustment by the user. The reduction in weight was accomplished by reducing the size of the transmitter and receiver elements and omitting some of the parts which were provided for adjustment of the 52-B. The microphone boom of the 52-B was replaced by a removable horn which was used to convey the speech from the mouth to the transmitter element located near the earpiece. The earpiece pressure was reduced to eight ounces as compared to fourteen to sixteen ounces for the 52-B.

Forty controllers were selected to participate in the trials. This selection represented a cross-selection of different usage, head shapes and sizes, ages, and environment. Operating positions were selected to include those close to Teletype machines and other sources of background noise.

Half of the controllers were given MS-50 headsets and the other half were provided with Y-1 headsets. After two weeks usage with that arrangement the distribution was reversed so that those who had used the MS-50 now had the Y-1 and vice-versa.

The test data were gathered by means of written questionnaires. Four questionnaires were completed by each controller at the following times:

1. Prior to issue of the new headsets.
2. After two weeks use of one of the new headsets.
3. After two weeks use of the other new headset.
4. At the end of the trials.

The results obtained from the first three questionnaires are shown in Appendix I, and are summarized as follows:

<u>General Comments.</u> The comments of the Type 52-B headset were that it was cumbersome, heavy, uncomfortable, hurt the ears, would not stay in adjustment, and caused headaches. The comments on the Y-1 indicated that it was somewhat of an improvement, but was still uncomfortable and hard on the ears. The general comments on the MS-50 were varied in nature; however, the majority were favorable. Complete lists of the comments on each of the three headsets are contained in Appendix II.

<u>Comfort</u>. In answer to the question, "Do you find this headset comfortable?" the results for the three headsets were as follows:

	52-B	Y-1	MS-50
Very comfortable	0%	7.5%	62.5%
Moderately comfortable	12%	37.5%	20 %
Not very comfortable	67%	42.5%	15 %
Unsatisfactory	21%	12.5%	2.5%
Total	100%	100%	100%

The major reasons given for discomfort when using the 52-B were the weight, headband, and receiver cap. The reasons given for discomfort when using the Y-1 were the headband and the receiver cap. Reasons given for discomfort with the MS-50 were the headband and earpiece. Both the 52-B and Y-1 headsets had to be removed as often as 20 or more times during the day for comfort. The controllers found it necessary to remove the MS-50 a maximum of 10 times a day for comfort and 42.5 percent found it unnecessary to remove the headset at all.

The Y-1 headset was found to be more comfortable than the 52-B by 40 percent of the controllers, while 87.5 percent found the MS-50 to be more comfortable than the 52-B.

Convenience. In answer to the question, "Do you find this headset convenient to use?" the results for the three headsets were as follows:

	52-B	Y-1	MS-50
Very convenient to use	2.5%	2.5%	40%
Moderately convenient to use	57 %	52.5%	35%
Not very convenient to use	36 %	37.5%	20%
Unsatisfactory	4.5%	7.5%	5%
Total	100 %	100 %	100%

The Y-1 headset was found to be more convenient to use than the 52-B by 12.5 percent of the controllers while 60 percent found the MS-50 more convenient than the 52-B.

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Ability to Hear. In answer to the question "How would you rate your ability to hear on this set?" the results for the three headsets were as follows:

	52-B	Y-1	MS-50
Excellent	9.5%	55%	65 %
Good	69 %	15%	12.5%
Fair	21.5%	30%	10 %
Poor	—	—	10.7%
Unsatisfactory	—	—	2.5%
Total	100%	100%	100%

Seventy percent of the controllers felt that they could hear better when using the MS-50 than when using the 52-B, while only 32.5 percent felt that they could hear better with the Y-1 than with the 52-B.

Fifty percent felt that the MS-50 was better than the 52-B with respect to interference from room noise, while only 27.5 percent found the Y-1 to be better.

Ability to be Heard. In answer to the question "How would you rate the ability of others to hear you on this headset?" the results for the three headsets were as follows:

	52-B	Y-1	MS-50
Excellent	10 %	20 %	67.5%
Good	73.4%	50 %	27.5%
Fair	14.2%	17.5%	5 %
Poor	2.4%	7.5%	—
Unsatisfactory	—	5 %	—
Total	100%	100%	100%

The ability to be heard was felt to be better than with the 52-B by 62.5% percent of the controllers when using the MS-50, and by 15 percent when using the Y-1.

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Overall Rating. In answer to the q. stion, "What overall rating would you give this head. et?" the results for the three headsets were as follows:

	52-B	Y-1	MS-50
Excellent	——	7.7%	53.9%
Good	21.4%	23.0%	25.6%
Fair	52.4%	51 %	15.4%
Poor	26.2%	18.3%	5.1%
Total	100%	100%	100%

The MS-50 headset was preferred over the 52-B headset by 75 percent of the controllers, while only 27.5 percent preferred the Y-1 over the 52-B.

The fourth questionnaire was given after the controllers had used each of the headsets and were in a position to make a comparative evaluation with respect to the factors previously considered. The results are contained in Appendix III and are summarized as follows:

	52-B	Y-1	MS-50	No Difference	Total
Most Comfortable Headset	0%	11%	89%	0%	100%
Most Convenient to Use	10.5%	34%	52%	3.5%	100%
Most Satisfactory to Hear	7 %	16%	66%	11 %	100%
Most Satisfactory to be Heard	18 %	0%	41%	34 %	*93%
Overall, Headset Preferred	7 %	16%	77%	0%	100%

*Left blank by 7%

Plans for Further Development

The results of the laboratory tests and operational trials have shown that the MS-50 headset is generally suitable for use in the air traffic control environment and is preferred over both the 52-B and the Y-1 by a majority of the controllers. The controllers' comments have been of great value in the development of the lightweight headset and have

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led to a number of proposed improvements, among which are an adjustable headband, a more secure capsule clip, a more positive action handswitch, and lighter retractile cords. It is planned that these improvements will be incorporated in the next procurement of developmental headsets and that further operational trial will be conducted in Centers, IFR Rooms, and Towers at a number of locations specified by the Air Traffic Service.

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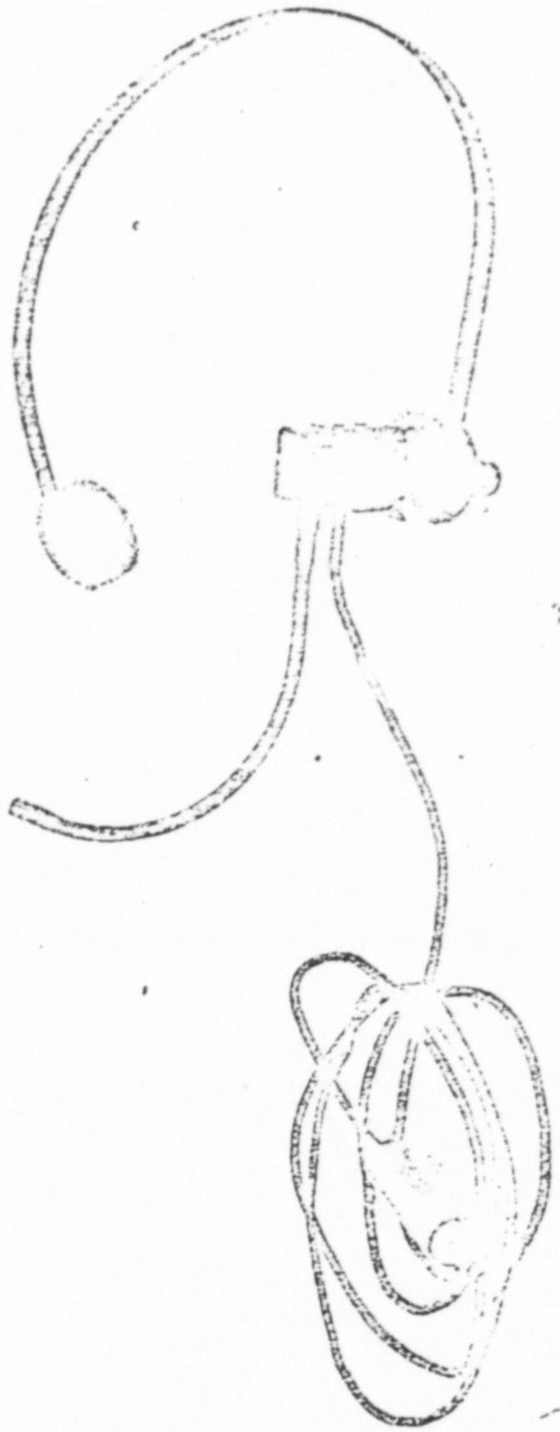

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FIG. 2 MS-50 HEADSET WITH HEADBAND

FIG. 3 MS-50 HEADSET CLIPPED TO EYEGLASSES

69

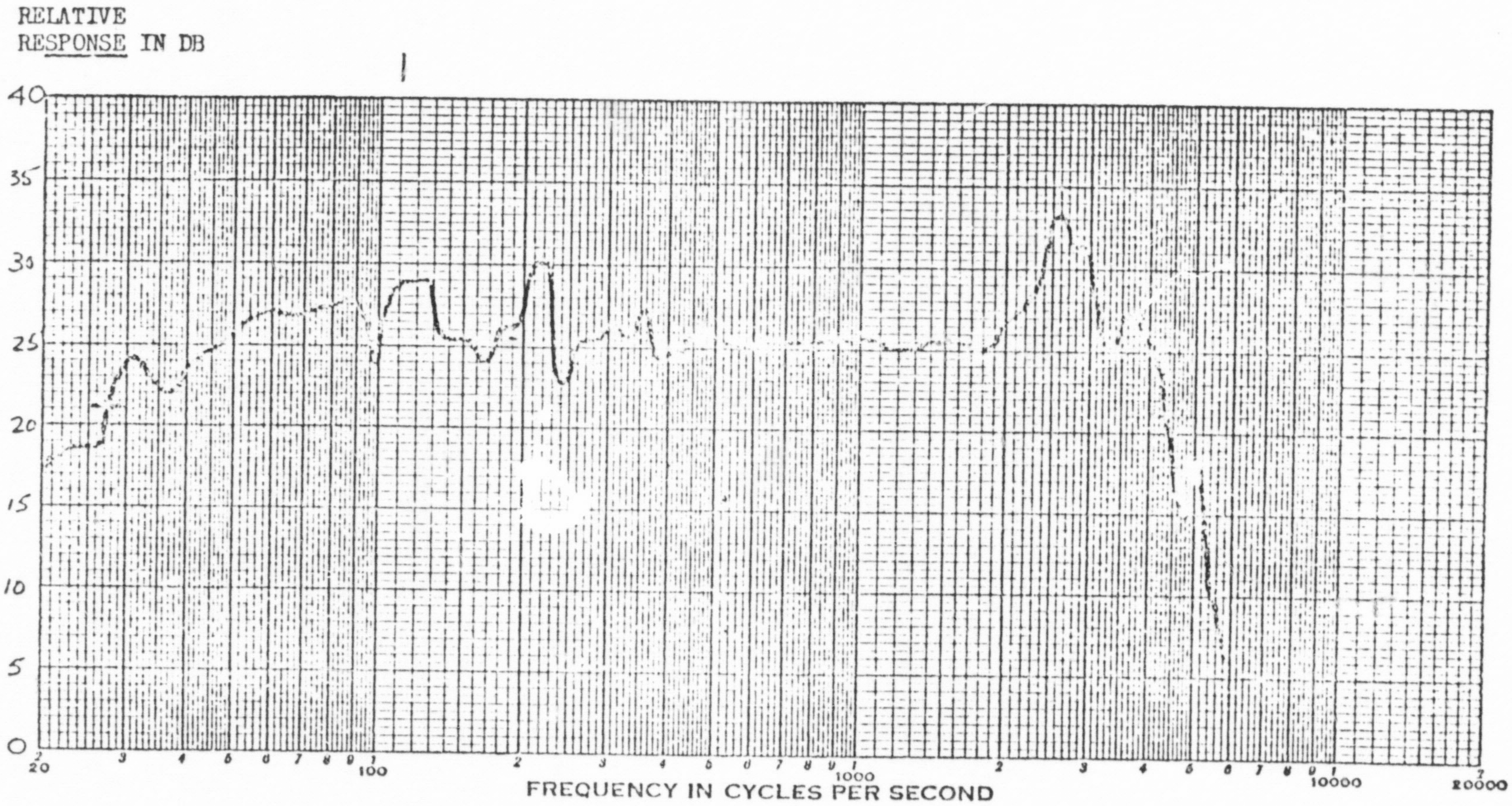

FIG. 4 52-AW MICROPHONE RESPONSE

70

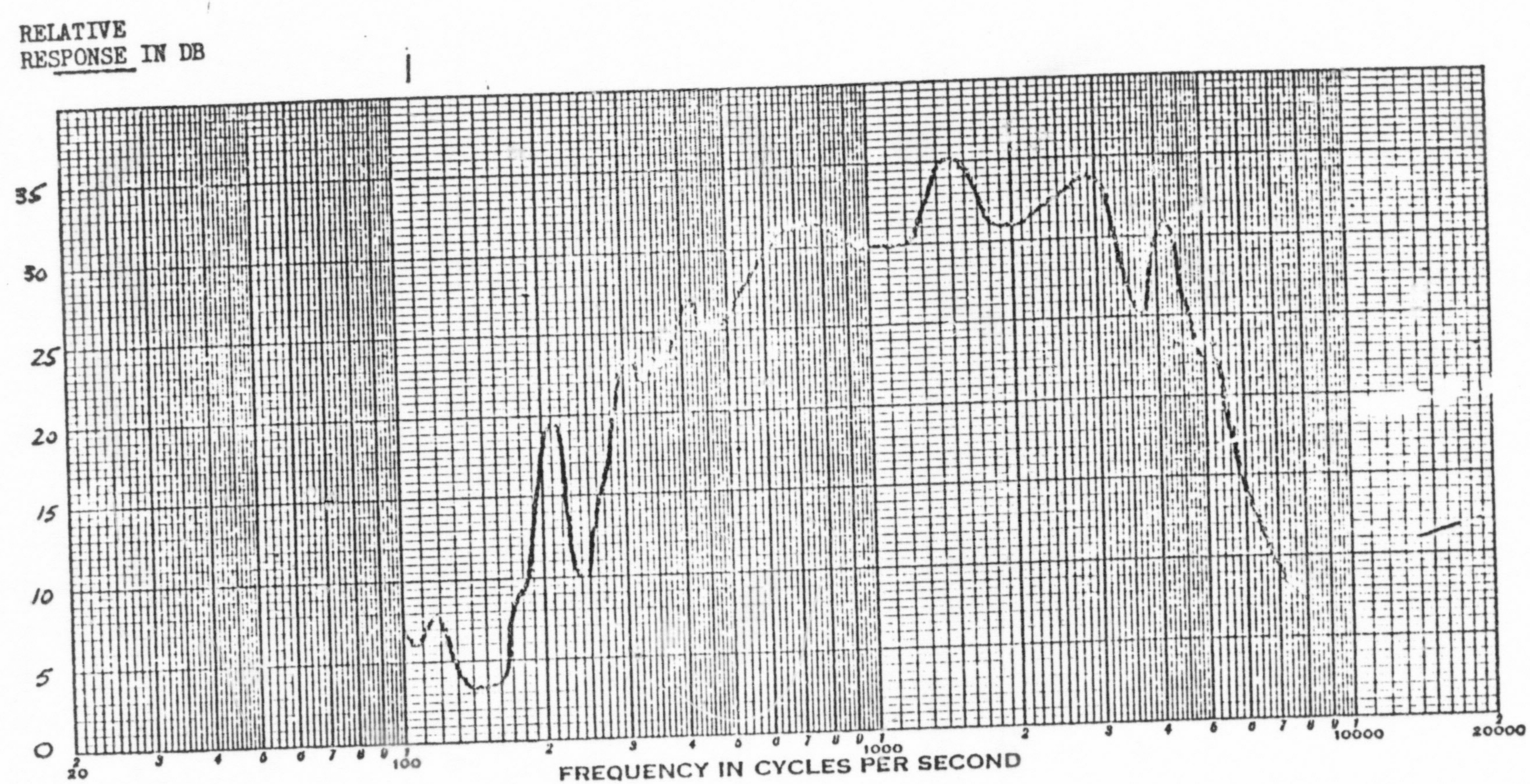

FIG. 5 MS-50 TRANSMI[illegible]ER/AMPLIFIER RESPONSE

(71)

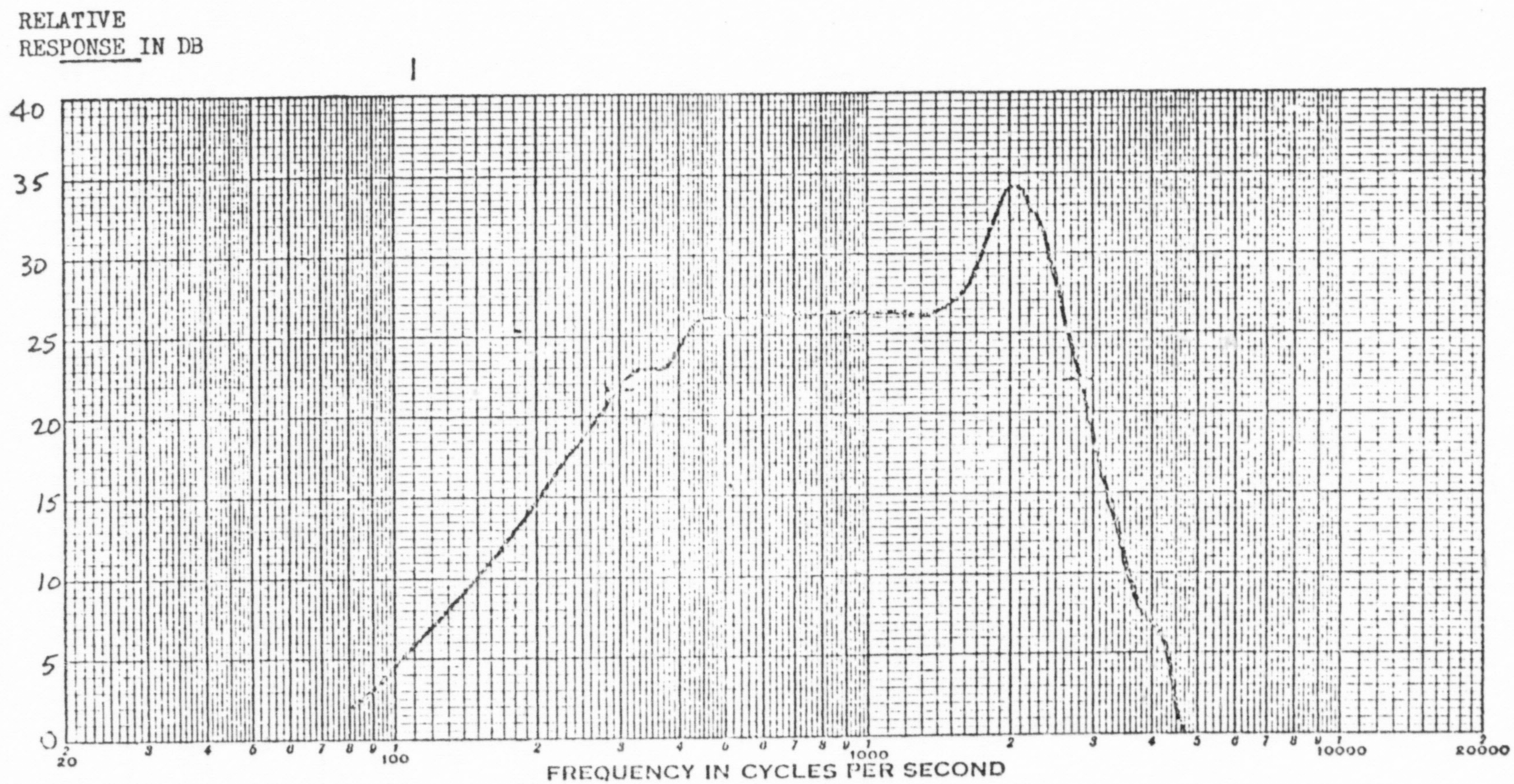

FIG. 6 52-AW RECEIVER RESPONSE

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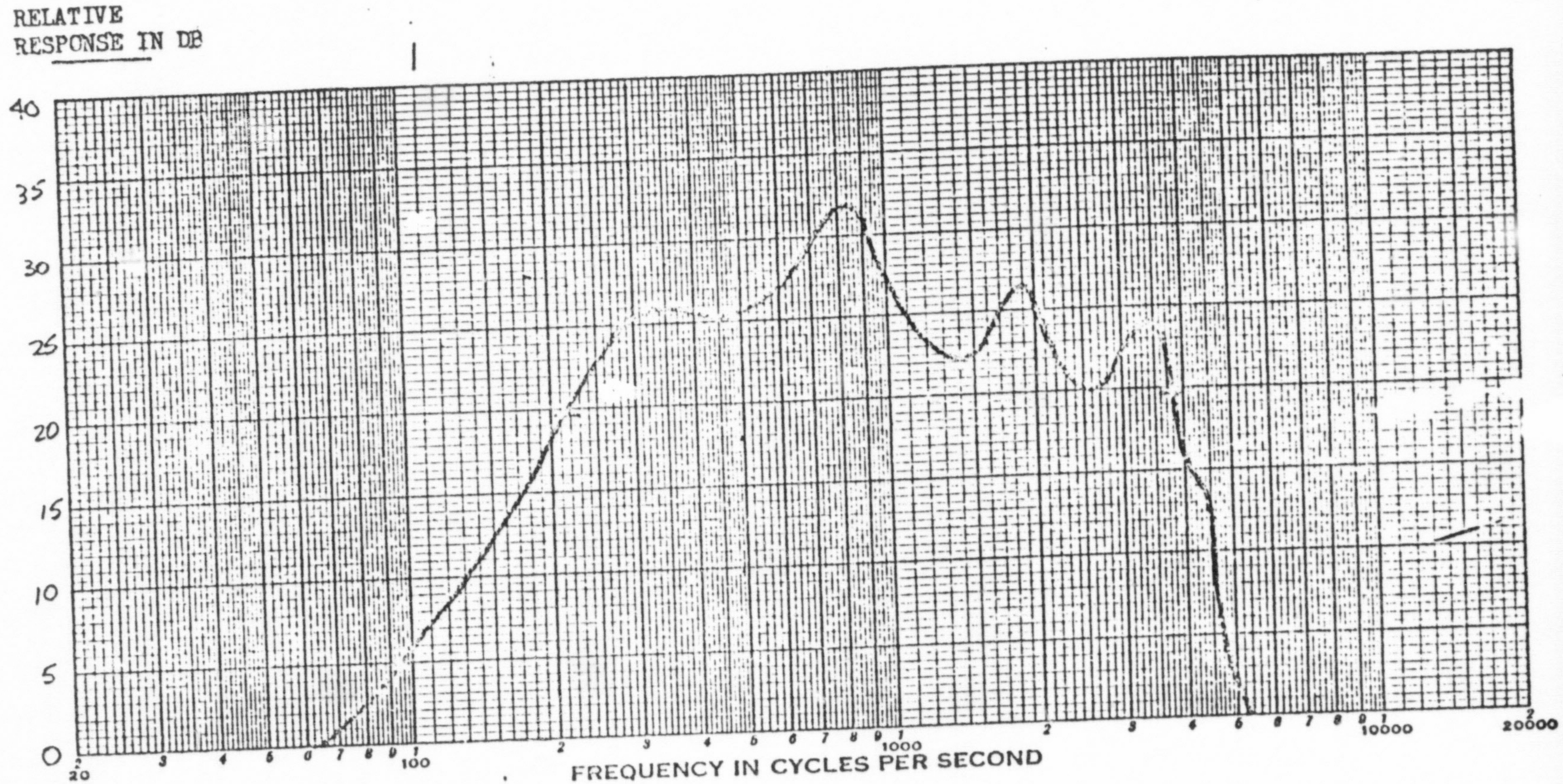

FIG. 7 MS-50 RECEIVER RESPONSE

FIG. 8 - RESPONSE OF 52-AW TRANSMITTER TO VOICE

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

FIG. 9 - RESPONSE OF MS-50 TRANSMITTER TO VOICE

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

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FIG. 10 - 52-AW TRANSMITTER RESPONSE SHOWING WIND NOISE AND SIBILANTS TO THE WORD "SUCCCTASH".

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

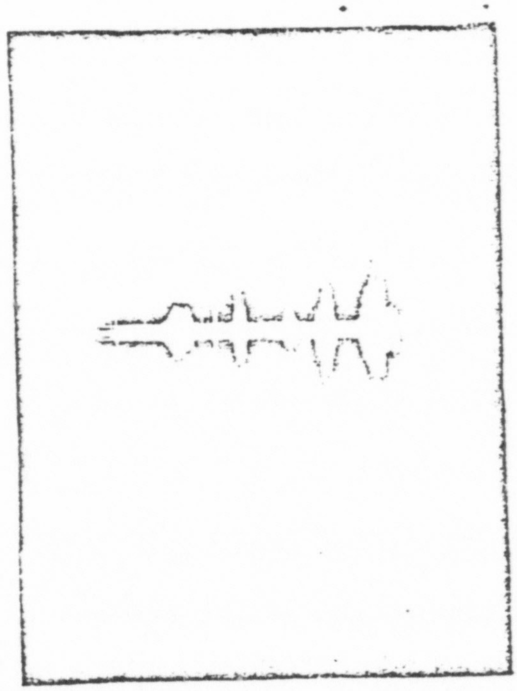

FIG. 11 - MS-50 TRANSMITTER RESPONSE TO THE WORD "SUCCOTASH"

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

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FIG. 12 - 52-AW RESPONSE TO NODDING THE HEAD AS IF SAYING "NO"

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

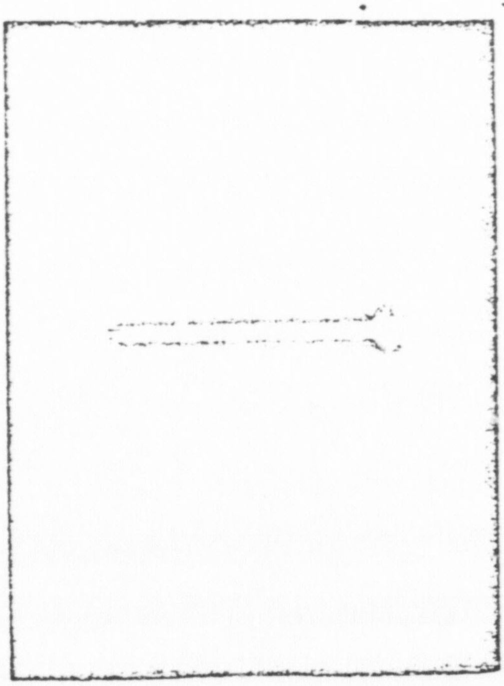

FIG. 13 - MS-50 RESPONSE TO NODDING THE HEAD AS IF SAYING "NO"

VERT. 0.5V/CM
HORIZ. 0.1SEC/CM

APPENDIX I

Results of Questionnaires I, II and III

	PERCENT RESPONSE		
	52-B	Y-1	MS-50
Participants 40			
1) Comments: See Appendix II	62	65	62.5
2) Do you find this headset:			
Very comfortable	0	7.5	62.5
Moderately comfortable	12	37.5	20.0
Not very comfortable	67	42.5	15.0
Unsatisfactory	21	12.5	2.5
Participation	100	100	100
2A) If "not very comfortable", or "Unsatisfactory", was it due to the:			
Headband	24	22.8	5.5
Receiver Cap or Earplug	28	19.5	9.8
Weight	36	8.1	0
Other (describe)	0	4.6	2.2
Participation	88	55	17.5
3) For reasons of comfort, how many times did you find it necessary to remove the headset during the working day?			
Never	0	7.5	42.5
1-5	21.4	35.0	45
6-10	38	27.5	10
11-20	28.6	22.5	0
Over 20	12.0	5.0	0
Participation	100	97.5	97.5
4) How did the headset compare in comfort with the one you normally used?			
More comfortable	N/A	40	87.5
About the same	N/A	27.5	2.5
Less comfortable	N/A	32.5	10
Participation	N/A	100	100

APPENDIX I

Results of Questionnaires I, II and III Cont'd.

	PERCENT RESPONSE		
	52-B	Y-1	MS-50
4A) If more or less comfortable, please check the categories which best describe your opinion:			
a) Headband			
More comfortable than the one you normally used:	N/A	50	85
About the same:	N/A	15	5
Less comfortable than the one you normally used:	N/A	22.5	7.5
Participation	N/A	87.5	97.5
b) Receiver Cap or Earplug			
More comfortable than the one you normally used:	N/A	17.5	67.5
About the same:	N/A	32.5	10
Less comfortable than the one you normally used:		35	22.5
Participation	N/A	85	100
c) Other (Describe)			
5) Do you find this headset:			
Very convenient to use:	2.5	2.5	40
Moderately convenient to use:	57	52.5	35
Not very convenient to use:	36	37.5	20
Unsatisfactory:	4.5	7.5	5
Participation	100	100	100
6) How does it compare in convenience with the headset you normally use?			
More convenient:	N/A	12.5	60
About the same:	N/A	47.5	5
Less convenient:	N/A	40	35
Participation	N/A	100	100

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APPENDIX I

Results of Questionnaires I, II and III Cont'd.

	PERCENT RESPONSE 52-B	Y-1	MS-50
7) How would you rate your ability to <u>hear</u> on this set?			
Excellent	9.5	55	65
Good	69	15	12.5
Fair	21.5	30	10
Poor	N/A	0	10
Unsatisfactory	N/A	0	2.5
Participation	100	100	100
8) Do you feel your ability to hear is better when using:			
New headset	N/A	32.5	70
Headset normally used	N/A	5	22.5
No difference	N/A	62.5	7.5
Participation	N/A	100	100
9) Did room noise ever interfere with your ability to hear?			
All of the time	2.4	0	5
Most of the time	14.2	10	10
Some of the time	83.4	72.5	62.5
Never	N/A	17.5	22.5
Participation	100	100	100
9A) How does this compare with your old headset?			
Better	N/A	27.5	55
About the same	N/A	60	22.5
Inferior	N/A	12.5	22.5
Participation	N/A	100	100
10) How would you rate the ability of <u>others</u> to hear you on this set?			
Excellent	10	20	67.5
Good	73.4	50	27.5
Fair	14.2	17.5	5
Poor	2.4	7.5	0
Unsatisfactory	0	5	0
Participation	100	100	100

APPENDIX I

Results of Questionnaires I, II and III Cont's.

	PERCENT RESPONSE		
	52-B	Y-1	MS-50
11) Do you feel your ability <u>to be heard</u> is better when using:			
New headset	N/A	15	62.5
Headset normally used	N/A	27.5	22.5
No difference	N/A	57.5	12.5
Participation	N/A	100	97.5
12) Did you feel that the adjustment of your transmitter was:			
Good	38.1	25	67.5
Fair	38.1	27.5	22.5
Poor	21.4	30	5
Unsatisfactory	2.4	17.5	0
Participation	100	100	95
13) Did you ever use this set as a hand-held set instead of wearing it?			
Yes	71.5	52.5	27.5
No	28.5	47.5	72.5
Participation	100	100	100
13A) If yes, how ofter?			
0-25%	64.5	48.2	25.5
25-50%	7	4.3	2
Participation	71.5	52.5	27.5
13B) If yes, when using this set as a hand-held set would you rate it as:			
Good	7.5	25.1	8.6
Fair	31	18.3	10.5
Poor	13	6.8	4.2
Unsatisfactory	20	2.3	4.2
Participation	71.5	52.5	27.5

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APPENDIX I

Results of Questionnaires I, II and III Cont's.

	PERCENT RESPONSE		
	52-B	Y-1	MS-50
14) Did the headset obstruct your view?			
Not at all	71.5	60	100
Very little	16.7	17.5	0
Sometimes	11.8	20	0
Participation	100	97.5	100
15) Do you normally wear glasses while working?			
Yes	24	12.5	25
No	76	87.5	75
Participation	100	100	100
15A) If yes, did you wear the headset on the glasses? (For Plantronics users only)			
Yes	N/A	N/A	35
No	N/A	N/A	0
Participation	N/A	N/A	35
15B) If yes, how often ?			
75-100%	N/A	N/A	30
50-75%	N/A	N/A	0
25-50%	N/A	N/A	2.5
1-25	N/A	N/A	2.5
Never	N/A	N/A	5
Participation	N/A	N/A	40
16) What overall rating would you give this headset?			
Excellent	0	7.7	53.9
Good	21.4	23.0	25.6
Fair	52.4	51	15.4
Poor	26.2	18.3	5.1
Participation	100	100	100
17) Overall, do you prefer:			
New headset	N/A	27.5	75
Headset you normally use	N/A	55	20
No preference	N/A	17.5	5
Participation	N/A	100	100

APPENDIX II

A. Controller Comments on Type 52-B Headset

1) General Comments

1. Mouthpiece occasionally falls down.
2. It is too cumbersome and heavy for our mobile requirements.
3. Too heavy; I have to constantly adjust it to my head; it slips off.
   Vain as it seems, it messes up my hair.
4. It is a durable piece of equipment but much too heavy and cumbersome for comfort.
5. It is bulky and very hard to wear. It hurts the ears a[illegible]
   Too cumbersome; creates painful ear at times.
6. Unsatisfactory because it is very uncomfortable to wear.
7. Too heavy.
8. Leaves much to be desired.
9. Too heavy and cumbersome.
10. I do not like the headset for continuous use.
11. Efficient and durable but uncomfortable.
12. Too heavy and cumbersome
13. Too heavy and cumbersome
14. Heavy and won't stay adjusted.
15. It is uncomfortable and will not stay in place.
16. Too heavy.
17. Can't get it to fit right.
18. Gets very uncomfortable; modulation seems poor.
19. Too heavy; not enough adjustments.
    Ear-piece too small. Very uncomfortable; cord too heavy; switch box too heavy; drags headset off.
20. Wear glasses and ear discomfort is a problem.
21. Head piece never stays permanent and ear becomes sore after a few hours; also occasional headaches.
22. After use, the headset seems to be one size and you can't adjust it.
23. Different people using the headset make it difficult to adjust it for myself.

2) If "not very comfortable", or "unsatisfactory" is it due to the: headband, receiver cap or earplug, weight, other?

1. Headband is either too loose or too tight. When too tight, receiver is very uncomfortable on ear.
2. All of the above describe the headset.

Comments on 52-B Headset Cont'd.

3. Receiver cap gives too much pressure about the ear; I believe caused by its weight.
4. The earpiece is tolerable by using a rubber pad.
5. Inability to hold shape and pressure on ear. (other)
6. Slips on pad; too tight on head and ear.
7. The weight of the switch (and cord?) is uncomfortably heavy.
8. When adjusted to stay on, it gives me a headache.
9. Keeps slipping off my head.
10. Wearing glasses the receiver cap is uncomfortable.

3) Do you find this headset convenient to use?

1. Main problem is size of mouthpiece.
2. Must keep shifting mouthpiece out of the way; falls off when you move head quickly.
3. Has tendency to come off.

4) How do you rate your ability to hear on this set?

1. The poor reception is usually due to the earpiece not fitting snugly.
2. It slips around and off the ear.
3. No trouble hearing at all.

5) Does room noise ever interfere with your ability to hear?

1. Especially if room noise is next to you.
2. If there is any room noise it will be heard.
3. That is not noise from the headset; it's noise coming in the other ear.
4. Outside noises and poor fit over ear combine for poor reception in busy times.
5. By pressing the ear-piece it's okay.
6. In the other ear.

6) How would you rate the ability of others to hear you on this set?

1. This trouble is usually caused by position of mouthpiece.
2. Depends on the position and distance from mouth. For good capability it must be right in front.
3. Have to hold mouthpiece while transmitting.
4. They will hear you good if you have the speaker (xmtr) placed properly.

7) Do you feel that the adjustment of your transmitter is good?

1. Has a tendency to falldown; it has poor adjustments.

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Comments on 52-B Headset Cont'd.

2. Adjustment of headset is poor.
3. No adjustment.
4. Does not adjust in enough directions.
5. Too heavy.
6. Too heavy.
7. Most of the time (Fair)

8) Do you ever use your headset as a hand-held set instead of wearing it?

1. Rarely
2. Very seldom
3. Quite rare except when working more than one sector and then only for short periods.
4. All the time!
5. I have in the past but not now.
6. Very poor as used as a handset.
7. It's too difficult to handle this way.
8. Sometimes
9. Multi-sector (when working mid-shift)
10. Occasionally I will take the headset off during periods of light or no traffic. When an airplane calls, I will use it as a handset.

9) If yes, when using the set as a hand-held set would you rate it as good?

1. Reason for holding the set is the lesser of two evils as it is so uncomfortable to wear.
2. It would be poor (if) so used.
3. Handling (Fair)

10) What overall rating would you give the headset you are now using?

1. It has caused a calcium buildup in my left jawbone due to its weight and pressure, causing a medical problem.
2. As far as transmitting and receiving, excellent. (Poor) wearing it.
3. Mechanically good; poor for user comfort.

11) Approximately how many times do you remove your headset during an average working day?

1. Close to 4-5 times per day.
2. As much as possible.

Comments on 52-B Headset Cont'd.

12) Any other comments:

1. Headset is hot and heavy; cord life is short and never seems (to fit) right.
2. Ear sweats under ear part and hurts after 4 hours.

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APPENDIX II

B. Comments on Type Y-1 Headset

1) General Comments

1. Receiver cap was too uncomfortable; seems to cut into the ear.
2. Too bulky.
3. Other than weight not much of headset.
4. I would not desire to change to this headset.
5. Better than 52, but not the one, pilots have difficulty hearing transmissions.
6. Ability to hear is slightly improved; otherwise no basic improvement.
7. Not as satisfactory as the old headset.
8. Both the spiral and the headset-to-switch cord(s) are too short. The pass-through feature of the cord through the switch is good but the switch itself is too large and bulky.
9. Headset broke. Was used for three days only.
10. Headset is better looking and light weight but not worth a change. The xmtr (mouthpiece) makes it inconvenient to eat or drink without taking set off or removing mouthpiece.
11. The headband is an improvement.
12. It is acceptable.
13. I do not feel that this headset is much improvement over the old one except for weight.
14. No appreciable improvement over the old set.
15. I do not like it one bit, and I have red ears to turn in with it.
16. More comfortable than present set. Pilots sometimes complain about hearing me. I think this is due to the position of the mouthpiece.
17. Much improved over the 52-B; lighter, more comfortable for longer periods. Is still uncomfortable after 2-3 hours. It presses in on ear and headset opposite.
18. Much better than the old headset.
19. I don't like it.
20. It is better than the old one but aircraft said we were muffled and not too clear.
21. Not any better than the type 52; in fact not as good. Does not adjust enough; the ear piece hurts after 2 hours.
22. It's better than the old one (52-B)
23. It is no better than the old one.

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Comments on Y-1 Headset Cont'd.

24. Don't like it. Hurts my ear. Pick up too much background noise.
25. Very heavy after having worn it for a period of time.
26. Makes the ear sore after a couple hours work.
27. This headset was unsatisfactory due to being too small and not enough adjustments. Cord too short.

2) If "not very comfortable", or "unsatisfactory", was it due to the headband or other?

1. I adjusted the set every way I could but it still hurt my ear. Possibly, if the headband was shorter, it may help, but as it stands too much pressure is applied inward so it has a tendency to hurt.
2. Transmitter awkward.
3. Earpiece still needs improving; my ear is still sore. Mouthpiece also could be made to clear the mouth area easier.
4. Pressure on the ear and cheek after several hours of use.
5. Mouthpiece just too bulky; also cord from mouthpiece to switch too stiff; switch too bulky.
6. Mouthpiece is awkward and in the way; does not adjust satisfactory, and has to be close to mouth.
7. Very bothersome to the top portion of the ear.
8. Too bulky.
9. More tension than the other (52-B?) even after attempting to "spread it out" causing irritation to the ear.
10. Mouthpiece (under "other")
11. First few days unsatisfactory. After springing headband several times, the headset was comfortable.
12. Receiver cap pressed against ear and caused considerable pain. Headband pressed down on top of head too hard.
13. (Comfortable) Only up to 3-hours f constant wear.
14. Too tight.
15. With glasses it pinched my ear.
16. Cord too short; switch heavy.
17. The belt switch is too big; the earpiece is too small.
18. Not adjustable enough. Switch was too big and awkward.
19. Too tight.
20. Too much pressure on the ear.
21. Mouthpiece too short, not enough adjustment on earpiece.

3) For reasons of comfort, how many times did you find it necessary to remove the headset during the working day?

1. I would hate to comment on the amount because every time I had a chance I was either moving it around or trying to adjust it for more comfort.

Comments on Y-1 Headset Cont'd.

2. Reason, sore ear.
3. Hurts ear over period of time.
4. Pressure on ear.

4) How did the headset compare in comfort with the one you normally used?

1. It seems less pressure has to be (used with) 52 than on the 46 BTC (Y-1) to keep it from moving around as I move my head, making it more comfortable.
2. Less weight.
3. (About the same) except headband.
4. (Less) Maybe because I was used to the old one.
5. Not as heavy. Does not fall off as easily.

4A) Headband

1. Less weight, exposed wire bands hard on bald heads.
2. Headband cross member broke first day - then more uncomfortable.
3. The headband is comfortable at first but after a while it causes a headache and it causes the outside of the ear to be sore.

4B) Receiver Cap or Earplug

1. Too flat
2. As I said before, there is too much pressure on the ear.
3. Ear sweats and (it) flattens ear.
4. Pressure
5. Irritated my ear and, very hot. Seemed to press too hard.
6. Too hard.
7. See comment A (4A 3 above) I think these two are connected.
8. Too much pressure and too big.

4C) Other (describe)

1. Mouthpiece too bulky.
2. Mouthpiece not as good.
3. The transmitter is not made right; it get(s) in the way.

5) Do you find this headset (convenient)?

1. Shoe horn mouthpiece in the way.

Comments on Y-1 Headset Cont'd.

2. Cord between the hand switch and headpiece is located on wrong side of hand switch for hand usage.
3. Adjustment of mouthpiece away or to mouth.
4. Hand switch too bulky and cord too short.
5. Unsatisfactory in comparison to present handset.
6. No swing-away mouthpiece, too heavy; switch box too heavy.
7. To move mouthpiece you have to also move earpiece which is inconvenient.
8. Too hard to adjust.
9. The mouthpiece cannot be moved easily enough.

6) How does it compare in convenience with the headset you normally use?

1. Headset more comfortable but mike awkward.
2. Not enough adjustment.
3. Because of mouthpiece.
4. Needs an adjustment Ref: the horn in front of the mouth.
5. Cord too short; hand switch too bulky for me; must keep mouthpiece too close to mouth (it's much more critical in this area than the old)
6. Mouthpiece too stationary
7. Don't like mouthpiece; always in the way.
8. It took both hands to move mouthpiece and was clumsy to use due to length of cord and switch.

7) How do you rate your ability to <u>hear</u> on this set?

1. Pick up a lot of adjacent noise.
2. It's very good but must remain <u>right</u> over ear causing uncomfort as it can't be moved to rest half on ear and half on jawbone.

8) Do you feel your ability to hear is better using the New Headset?

1. (N-D) slightly better.
2. More feedback (with new)
3. It's better only so long as it is placed directly over the ear. (see 7)2 above.

9) How does this (room noise QRM) compare with your old headset?

1. Noise factor (about the same)

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Comments on Y-1 Headset Cont'd.

10) How do you rate the ability of others to hear you on this set?

1. Had many pilot complaints on readability.
2. This was tested for quality during slack periods - all pilots agreed that a handset of the Type 52 headset was very much more readable. All the time, during trial period, many repeats were necessary.
3. But they pick up too much background noise.
4. Still outside noise. Pilots advised the noise was sometimes such that I was hard to understand over the radio. Pilots advised when I had it directly in front of my mouth, there was a hiss of breath. The old headset was quieter.
5. Had complaints on both interphone and radio every time the mouthpiece was not directly in front of my mouth.
6. Pilots complained. I never had complaints of pilots' ability to hear me before.
7. I had no complaints.
8. Radio only (difficulty). Interphone was okay.
9. Some pilots report more background noise.
10. On the radio the a/c (air corps) have trouble hearing.
11. Many complaints - weak

11) Do you feel your ability to be heard is better when using New Headset?

1. See preceding comment (#10)2. above)
2. Same comments (as #10)5. above)

12) Did you feel the adjustment of your transmitter was good?

1. The mouthpiece is too far to the side. I have a tendency to talk through the corner of my mouth. (Interesting - no comment on 9), 10), or 11).

2. It came apart on several occasion(s).
3. The switch on this set is the best.
4. Pilots advised I was hard to understand. Gets in the way.
5. Too large and bulky.
6. Need an adjustment to flip transmitter out of your way when drinking coffee, etc.
7. Too stationary.

Comments on Y-1 Headset Cont'd.

13) Did you use this set as a hand-held set instead of wearing it?

1. Same as old set.
2. (Yes) Very seldom, however.

14) Did the headset obstr your view?

1. Shoe horn mouthpiece.
2. Except when drinking coffee at control position. Mouthpiece does not move.
3. Transmitter catches the eye at times either left or right (rest is cut off at bottom of page - WEST on Jan. 7)
4. But it did effect my smoking, coffee and (rest cut off at bottom of page) the mouthpiece around.
5. (bothers) just coffee drinking.

15) Do you normally wear glasses while working?

1. Probably 10% of the time I do wear glasses.
2. This set was more comfortable while wearing glasses than 52-B.

16) What overall rating would you give this headset?

1. Better than good but still needs improvement to be excellent.
2. Has a lot to be desired in this work. The weight is the only advantage.
3. No change in comfort generally speaking as each improvement seems to include a disadvantage.
4. Need a longer cord and different mouthpiece.

17) Overall, do you prefer the New Headset?

1. Better adjustment on Y-1 headset.
2. Preferably Plantronics
3. Plantronics is the better.

18) Any other comments:

1. Unadjustable.
2. All my comments are in the previous questions.
3. Light weight and earpiece; mike awkward; wide headband a detriment.
4. Transmitter extension should be longer or have several length extensions to provide a choice on adjusting

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Comments on Y-1 Headset Cont'd.

18)4. (Cont'd.) transmitter to the mouth. Also I am not in favor of a headband but can see no way to eliminate it on this headset.

5. Too warm, bulky, clumsy, hard to transmit speaker (mouthpiece?) too large; headband cuts into top of head; switch too big. I like the "Princess" color.
6. The difference is only noticable basically in weight. The switch is too wide. The improvement is not enough, if any, to warrant a change. It is slightly better in some respects and worse in others.
7. I believe the following combination would be better than any of the individual types:
   a. The switch and cord from the Plantronics set with the switch-to-headpiece (cord) portion shortened 12 inches.
   b. The earpiece and headband from the Y-1.
   c. The mouthpiece from the Type 52 including its swivelling ability.
8. The stretch cord is about 1 to 2 feet too short when using it at the coordinator position. Hard on the ear, the same as the #52 headset. The on/off switch when attached to belt will accidentally change to the "off" position by merely hitting the side of the chair. Without the footswitch this on/off switch would be unsatisfactory. Without individual headsets, the #52 headset is more practical when so many people are involved.
9. Receiver cap when wearing glasses was uncomfortable. When eating or drinking, the microphone (mouthpiece) would get in the way.
10. This headset should have been tested for transmission quality prior to our test which should be for comfort and convenience.
11. The mouthpiece is too sensitive to background noise.
12. The new headset is better with the exception of the mike (mouthpiece) and the mike in the old set was more versatile.
13. A good sturdy headset: could easily be applied to airtraffic control functions.
14. Any significant improvement over old headset other than being slightly lighter and is a little more comfortable, however has less flexibility than old. (I) do not prefer the Y-1 over the old set.

15. Although the horn can be separated from the set, it still isn't as good as the headset usually for moving mouthpiece out of way.

Comments on Y-1 Headset Cont'd.

16. Design of headset is of no great advantage or comfort. Headset is too heavy and too uncomfortable. Switch is too heavy. The cord is too short. The earpiece is hard and uncomfortable. Mouthpiece is too rigid with not enough adjustments such as lengthening the forward movement and swing-away feature.
17. To make the rubber padding more comfortable on headband, I would suggest a flatter piece covering more area so that pressure would be distributed over a larger area.
18. I have t(w)o objections which make the set unsatisfactory:
    1. After wearing it for awhile, it causes a headache and the ear to be sore.
19. The weight is a big improvement over the old one, but the transmitter hasn't enough adjustments. The ear pressure from this headset was hard on my ear.
20. This headset is not suitable to a person with a large head. Believe any person would become fatigued wearing it for any extended period of time while doing control work.

APPENDI II

C. Comments on Type MS-50 Headset

1) General Comments

1. Big improvement over the other headsets.
2. Very good if the earpiece is the correct size.
3. A very good headset when placed on glasses.
4. Excellent fidelity; 100% improvement over present type 52.
5. Cord from head to switch keeps twisting. Switch too cumbersome and bulky. Cord from switch to plug-in too heavy.
6. Switch wasn't very smooth.
7. It appears to be the ideal headset for air traffic control. Only minor changes are suggested!
8. The weight of this headset real good but at times find the earplug uncomfortable.
9. The stretch cord is about 3-ft. too long and the cord from headset to belt is about 1-ft. too long. The above changes should be satisfactory for all persons.
10. I do not think it is practical for airtraffic control work.
11. Very light weight.
12. This headset is by far superior to the previous set I have used. After becoming used to the earpiece, it is almost like wearing no headset at all.
13. I was very satisfied with the Plantronics model compared to all others - very light and convenient.
14. By far the best we have had.
15. Switch too heavy and picks up too much background noise.
16. I think this headset is great.
17. I like it very much because of light weight and it doesn't mess your hair and is (possible or easy) to drink liquids.
18. Very good.
19. It is much more comfortable on the ears and on the head, being much lighter. The switch tends to stick and doesn't depress to easily. The mouthpiece picks up quite a lot of background noise. On the whole it is a much better headset than the 52-B.

). Takes longer to adjust, especially the earpiece and transmitter, than the 52 or western (Y-1) sets.

21. A very worthy design; very light. The headset itself is very good. The cord and switch are too cumbersome.

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Comments on MS-50 Headset Cont'd.

22. I greatly approve of it.
23. Uncomfortable to wear because of the earpiece (plug). Sometimes the earpiece falls out and transmissions are missed.
24. It is a step in the right direction, but is presently unsatisfactory.
25. Too much readjustment.
26. Headband excellent; earplug very poor; mouthpiece fair.

2) Did you find this headset (comfortable)?

1. Would be more comfortable with glasses.
2. Not very comfortable when used with headband. (See 1)3. above)
3. Except for earplug.
4. After 4 days it made my ear sore.

2A) If "not very comfortable", or "unsatisfactory", was it due to (headband) etc:

1. Used my own glasses - very comfortable.
2. Very comfortable on glasses (see 2)2. above)
3. Headband slipping.
4. Unable to keep it in place.
5. After stretching the headband and adjusting it properly it became very very comfortable. (See 1)12. above)
6. It felt as though it was about to fall off my head.
7. Probably had a wrong size earplug, but it kept working too far into the ear - headband kept slipping.

3) For reasons of comfort, how many times did you find it necessary to remove the headset during the working day?

1. Would like a one piece unit with ear plug inside FELT BAND, then into ear.
2. Usually removed to leave the control position rather than comfort. It does require some time to replace this headset when returning to the position.
3. Once I put it on I usually left it on during the watch because of the time it takes to put on the headset and adjust properly.
4. (1 -5) or less.
5. (1 - 5) somedays never

Comments on MS-50 Headset Cont'd.

6. This was using the headset connected to eyeglasses. With the headband I removed the headset 1 or 2 times during a 4-hour period.
7. Sometimes my ear began to itch, but this happens with any headset.
8. The less I removed it, the better it was.
9. (1 - 5) Mostly to readjust.

4) How did the headset compare in comfort with the one you normally used?

1. No comparison (more comfortable)
2. A great improvement (more comfortable)
3. Old headset hard on the ear if left on for long periods of time.
4. There is getting use(d) to the 52; it is just uncomfortable all the time and this one works beautifully every way. (check off as "less comfortable"!)
5. This headset could be worn more than 8 hours without discomfort.
6. Except for earplug and having to readjust.

4A) Headband

1. Wore glasses and did not use headband.
2. Used glasses
3. I do not like the headband!
4. Used on glasses.
5. Hardly aware of it on the head.
6. In my case, I feel a shorter headband could have been even more comfortable.
7. No adjustment (should have some sort of adjustment).
8. However, (checked "more comfortable") an improvement would be to increase surface area of sponge material to reduce p.s.i.
9. I used the glasses frames. Very good.
10. (About the same) If I had it tight. It bothered me when loosened. It slipped therefore causing readjustment.

4B) Receiver cap or earplug

1. Earplug was a bit uncomfortable
2. (more comfortable) but disturbing to have <u>in</u> the ear.
3. Proper size plug is very important with this headset.

Comments on MS-50 Headset Cont'd.

4. I feel a cap would be more comfortable than a(n) earplug.
5. Very bothersome.
6. As I mentioned (in 4)4. above), after 2 or 3 days, I didn't even know I was wearing it.
7. Earplug not in the least bothersome.
8. The important thing is correct size of earplug; if correct, much more comfortable.
9. At first the earplug is "irritating" but after a couple of days not noticable.
10. Did not pressure my ear and after getting used to the earplug, it was fine.
11. The earplug was not annoying but I was unable to hear.
12. Reasons given before (same) (see 4A)10. above)

4C) Other

1. Except for the headband I found it very comfortable.

5) Do you find this headset (convenient, etc)?

1. A little slow to put on.
2. Would like mouthpiece and headset one piece.
3. To remove and replace takes more time and is less convenient than the 52.
4. It is necessary to remove plug and take complete headset (switch and cord) with you when leaving position rather than take headset off. It takes too much time to put back on.
5. Harder to put on - more subject to jerks and pulls by catching the cord.
6. Had to keep checking it to keep it in place.
7. With glasses it is hard to take off and put on.
8. Takes longer to remove and put back on.
9. If you remove or replace this headset very often, it takes too long to hook up or unhook. It is very convenient if left in place at all times.
10. From a standpoint of convenience, it is completly satisfactory.
11. Too much readjustment. I do not wear glasses; it looks ideal for those people.

6) How does it compare in convenience with the headset you normally use?

1. No comparison between the two. (MORE X)

Comments on MS-50 Headset Cont'd.

2. (Less X) Not as easy to get set up when first starting to work or if you want to take it off for a few minutes.
3. (Less X) When removing or from glasses. Very good for drinking coffee, etc.
4. (Less X) It takes longer to adjust.
5. (Less X) This would be for moving around a lot or changing positions.
6. (More X) (a) Headset to mike cord switch too long (believe he means cord between headset and switch)
   B. Not comfortable to hand (switch) use "(BELT OK)".
   C. Stowage of cord from glass to belt needs - (Rest cut off in duplication)
7. (More X) Weight alone is enough (to warrant the rating) but reception. SEEMS to be much better.
8. (Less X) Again (see 5)11. also) too much adjustment - with all three points - headband, earplug, and mouthpiece (tube)

7) How would you rate your ability to hear on this set?

1. I would like a shield to drown out outside noise.
2. Much better than normal.
3. Much better than other set.
4. Much better than other.
5. The only bad feature is interphone volume too low. Radio reception very good.
6. (Too faint to read - poor copy - BAIRD 1/4/63?)
7. Noted a little trouble on some interphone lines but believe the fault to be controller at other end not talking into mike.
8. Much lower volume was necessary compared to present headset.
9. No outside noise "(around me)" for that side of my head. It did pick up more on the transmit end (52).
10. Very poor; the ear plug doesn't always seem to work.
11. (Unsatisfactory X) I changed earplugs and headsets to see if the situation could be corrected.
12. (Poor X) Too much background noise.

8) Do you feel your ability to hear is better when using (new headset, etc.)?

1. (New X) Because of earplug.
2. (New X) Normally with the 52 I have to press on the earpiece to hear better, or louder, but (with) the Plantronics it was not necessary.

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Comments on MS-50 Headset Cont'd.

3. Same as above (see 7)5. above)
4. Radio was good.
5. (New X) First unit checked out was defective "(Weak)".
   2nd unit was excellent.
6. (Headset normally used X) Because with the tube earpiece background noise is kept out.

9) How does this compare with your old headset?

1. See item 7 (see 7)1. above)
2. Usually because of the other ear noise.
3. There is no comparison because the Plantronics is a pleasure to use "all" the time. I hear better, and others hear me better.
4. With the old headset, it was the noise around me (about the same X)
5. Reference to the ability to head (See 7)11. above)
6. Reasons previously given (see 7)12. and 8)6. above)

10) How would you rate the ability of others to hear you on this set?

1. The mike is very sensitive and can pick up side noise readily.
2. I was required to cup my hands around the mouthpiece to make sure they could hear me properly.
3. They hear me better than the 52.
4. Interphone excellent. Radio modulation sometimes only fair. Could be because of improper position of mouthpiece.
5. Some background noise.
6. There is still the "extended sensitive" area around the transmitting person (in front of the open tube). My theory is that the sensitive area must be decreased or the horn shield should be directed at the users mouth.
7. Mouthpiece is excellent.

11) Do you feel your ability to be heard is better when using: New Headset, etc?

1. (52 X) Because of background picked up on the transmitter - however this could be corrected quite easily.
2. Several occasions I stated to aircraft that I was using an experimental headset, if they were hearing me okay. They all stated my transmissions were fine.

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Comments on MS-50 Headset Cont'd.

3. No reported difference.
4. No difference noted.
5. Better reception cancels out the extra noise factor. No complaints from outside facilities.

12) Did you feel that the adjustment of your transmitter was good?

1. I had one that was not adjusted.
   NOTE: Some participants mistook the mike as transmitter for their r.f. transmitter.

13) Did you use this set as hand held? If yes, when so using, would you rate it as good.

1. Needs a better wrist loop.
2. Not applicable!
3. Can not be used as a handset.
4. Impossible to use.
5. It didn't seem to work this way.

14) Do you normally wear glasses while working?

1. But I will if need be! (No X)
2. Part of the time.
3. Sometimes. I knocked my glasses off!
4. I used the issue frames.
5. I expect to soon, so I used the frames.

15) What over-all rating would you give this headset?

1. (Fair X) Except for the transmitter - excellent.
2. (Fair X) Comfort is excellent but the ability to hear (See 7)11. above) reduces its effectiveness for me.
3. The only good thing about this headset is the mouthpiece (see 7)10. above)
4. (Fair X) Because of the earplug.
5. Even with the extended "sensitive area", I like the headset very well.
6. (Exc. X) With the reservation that a lighter cord be used.
7. Far superior to other
8. Best I have used.

(100)

Comments on MS-50 Headset Cont'd.

16) Over-all, do you prefer (New Headset, etc.)?

1. (New X) Definitely!!!
2. (No preference X) New Headset - not convenient to remove and replace. Old headset - good but hard on ear when left on for long periods of time. But this could possibly be corrected by having individual headsets.
3. Very convenient to use.

17) Any other comments:

1. The best headset yet (Plantronics)
2. Far Superior to old headset in every respect.
3. When transmitting or talking, there seems to be a lot of wind noise.
4. I scratches the inside of the glass(es) frame. Also, the cord between earpiece and switch seems to tangle, thus pulling the glasses. Should have a clip to attach to collar (or shirt pocket)
5. The cord between the transmitter - receiver on the head-band and the handkey unit is approximately 20-inches too long.
6. Ear piece should set in ear, not plug-in, and should be mounted on side of headband so would not set in ear. If the ear piece were of the type used in hearing aid and lighter(?) it would be much better (the last nine words were partly cut off in duplicator - FISHER dec. 17, 1962)
7. (Listed as follows):
   1. The cord from the headpiece to the switch should be shortened about 12-inches.
   2. Either a metal or larger (wider) plastic press-to-talk switch (button) should be placed in the hand switch unit.
   3. Transmitter tube should have hole in the side rather than the end.
   4. It seems an ear piece could also be made up for this unit so the headband could be done away with altogether.
8. Design a headset to fit on the ear with no band; to fit and balance over the ear using same earplug and mouthpiece. This will make it easy to remove and to put back on immediately with little or no adjustment.
9. (Listed as follows)
   a. The receiving volume is not readily adjustable as in type 52 by moving the earpiece.

(101)

b. It might be improved by making the tube to the earpiece (plug) longer. At present my slight pull pulls the earpiece loose.
c. The cord from the switch to the head unit is 10" too long and catches on objects.
d. The cord should pass through the switch.

10. When you are busy it is very difficult to keep adjusting this headset, and I don't believe it is very dependable for our type of work.
11. The clip that fastens on the glass(es) frame scratches same.
12. a. Mike too sen(s)itive - pick up noises around you.
    b. Awkward to put on in a hurry.
13. a. I kept the headset on all the time. I never had to remove it because it was uncomfortable but with the 52 I have to move it around continuously so it won't hurt.
    b. I cannot over-rate the Plantronics headset because for overall use it went beyond my expectations.
14. The speaking tube was stripped of its threads due to my own carelessness and flopped around until taped into position; still worked very well and it has all of my personal support as an excellent headset.
15. Much better than anything we have had before.
16. This headset could use a slight change in the transmitter with possibly more adjustment capability. Also, the receiver could be modified for those that do not wear glasses so it would hang on an ear hook.
17. (Listed as follows):
    a. With glasses it has loosened my frames removing the headset.
    b. Still need a much safer clip for the glasses to protect them from falling to the floor.
    c. The only adjustment I ever had to make was the earplug.
18. I like this new headset very well, and especially the light weight.
19. I believe the Plantronics set would be considered more practicable if a few changes could be made. I would like to see headband done away with altogether and a very light weight set be made to fit on the ear. Also the transmitter (mouthpiece?) be made so adjustment could be made easier, I think this set has very good possibilities.

Comments on MS-50 Headset Cont'd.

20. To improve this headset I would suggest incorporating the transmitter and receiver unit with an earpiece similar to the Telex earpiece. This would allow easy on/off with or without glasses, do away with the headband, and be the most convenient of any headset (New X)
21. Clip-on glasses was causing static elect. discharge between face and metal on ear piece clipped on glasses. Elect. tape on clips solved.
22. Cord is too heavy. Mike seemed to be too tight (switch) - what I would personally like to see is to take the "head" out of headset. Make an "Earset". I like the Plantronics as far as the weight, etc., is concerned but I would to have it, if possible, attached to your ear and have a speaker instead of an ear plug. The arm wasn't too good; the capsule kept coming off.
23. Suggest a heavier; one which will "cap" ear comfortably and have a "boom" "(mouthpiece)" that will swing away.

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APPENDIX III

Results of Questionnaire IV

Participants 29

1) Which headset is most comfortable?

	Percent Response
52-B	0
Y-1	11
MS-50	89
No difference	0
Blank	0
Total	100

1A) Which headset is least comfortable?

52-B	52
Y-1	41
MS-50	7
No difference	0
Blank	0
Total	100

2) Which headset is the most convenient to use?

52-B	10.5
Y-1	34
MS-50	52
No difference	3.5
Blank	0
Totals	100

2A) which headset is the least convenient to use?

52-B	31
Y-1	28
MS-50	34
No difference	3.5
Blank	3.5
Totals	100

3) On which headset can you hear most satisfactorily?

52-B	7
Y-1	16
MS-50	66
No difference	11
Blank	0
Totals	100

APPENDIX III

Results of Questionnaire IV Cont'd.

Participants 29

3A) On which headset can you hear least satisfactorily?

	Percent Response
52-B	55
Y-1	14
MS-50	20
No difference	11
Blank	0
Totals	100

4) On which headset can others hear you most satisfactorily?

52-B	18
Y-1	0
MS-50	41
No difference	34
Blank	7
Totals	100

4A) On which headset can others hear you least satisfactorily?

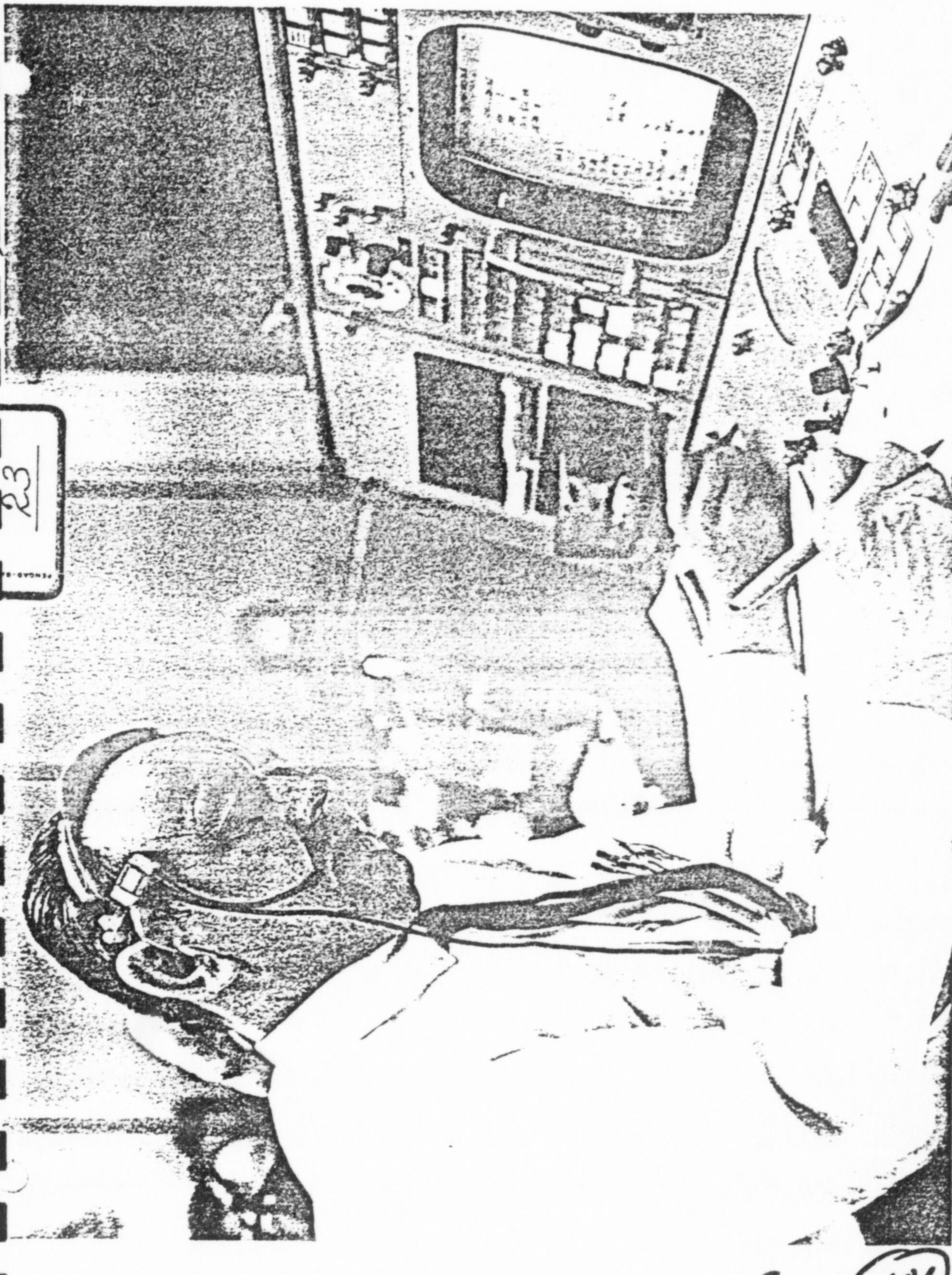
52-B	20.5
Y-1	28
MS-50	7
No difference	41
Blank	3.5
Totals	100

5) Over-all, which headset do you prefer?

52-B	7
Y-1	16
MS-50	77
No difference	0
Blank	0
Totals	100

5A) Over-all, which headset do you least prefer?

52-B	38
Y-1	48
MS-50	14
No difference	0
Blank	0
Totals	100



Ex. 23 (106)

EXHIBIT

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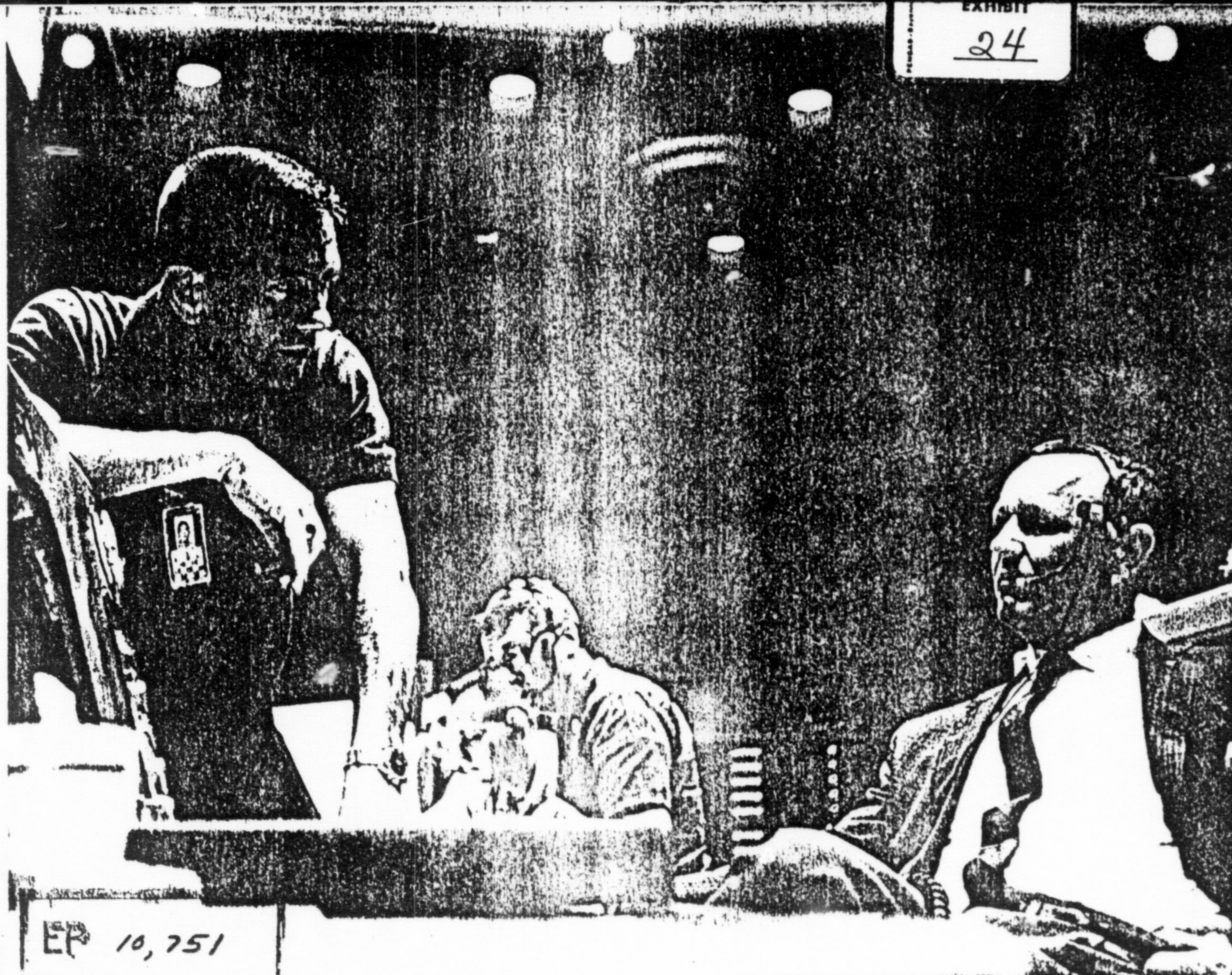
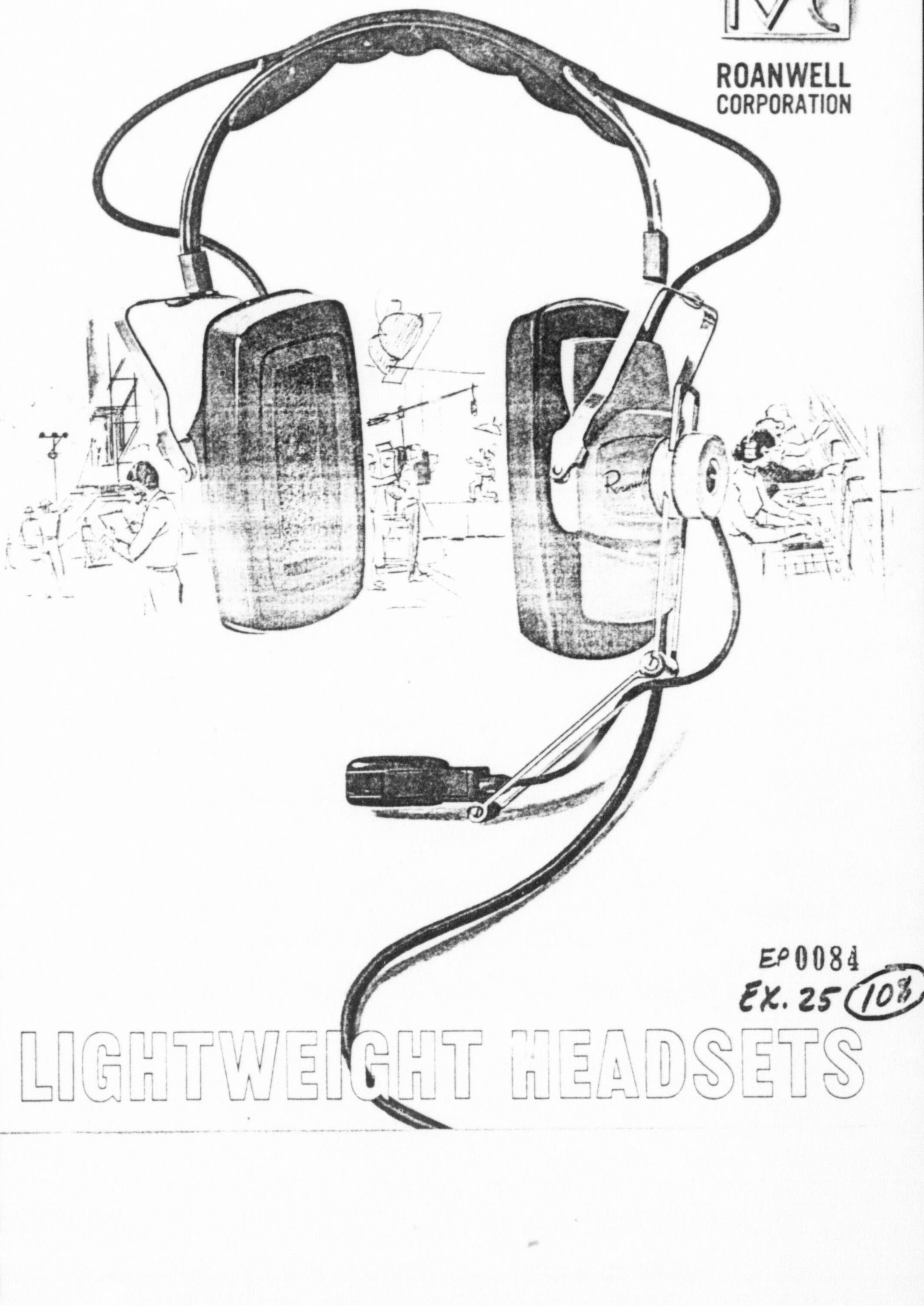


EP 10,751

Ex. 24 (107)

Exhibit 25

ROANWELL CORPORATION



EP 0084

EX. 25 (108)

LIGHTWEIGHT HEADSETS

ROANWELL CORPORATION'S

LIGHTWEIGHT HEADSETS

These four headset models are the standard configurations for Roanwell's line of Lightweight Headsets. Single ear cup models weigh 9 ounces, or less; double ear cup models weigh approximately 10 ounces.*

A wide choice of components makes it possible to design a Lightweight Headset to meet most applications. Listed on the next two pages are the components most frequently selected for use with these headsets. Other transducers, cords, switches and terminations are available for applications requiring custom designs.

Model RHM-1
Single ear cup headset, without microphone

Model RHM-3
Double ear cup headset, without microphone

Model RHM-2
Single ear cup headset, wire boom and microphone

Model RHM-4
Double ear cup headset, wire boom and microphone

A headband that fits securely and comfortably around the *back of the head* for use with a protective hard hat may be ordered with Models RHM-3 and RHM-4.

*Weights given exclude cordset and termination.

Designed for industrial and military applications, Roanwell's Lightweight Headsets offer:

Comfort for the Wearer: can be worn for hours without fatigue; lightweight cords allow greater freedom of movement. Soft, padded headbands are adjustable to keep the headset in place even when the wearer is active.

Technical Innovations: the miniature RE-300 Earphone Element weighs only 3/10 of an ounce and is an exclusive Roanwell design. This element is one-third the size and one-tenth the weight of competitive units of comparable performance.

Compact, lightweight Model RS-22 Switch Assembly has a built-in safety feature to prevent the switch from accidentally locking in the "ON" position.

Clear Communications are assured with dynamic, noise-canceling microphones; carbon, noise-canceling microphones; dynamic earphone elements and magnetic earphone elements.

Durable Construction for long wear and reliable performance. Roanwell's Lightweight Headsets are built to meet recognized Telephone Industry and Military quality standards.

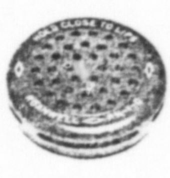
Color Selections: brown headband, beige ear cups, with brown cushions; black headband, gray ear cups, with black cushions.

COMPONENTS

Microphones—An adjustable wire boom is supplied with each Lightweight Headset configuration that specifies a microphone. This boom (with a dynamic microphone attached) is shown on Models RHM-2 and RHM-4. A mounting bracket on the boom will accommodate any of the following microphones.

A. Model RBM-101A Dynamic, Noise-Canceling Microphone
Sensitivity: −59 dB ref 1mW/Nm^{-2}
Frequency Range: 200 to 4500 Hz
Noise Cancellation: 15 dB average
Output Impedance: 6 Ohms

B. Model RBM-101B Dynamic, Noise-Canceling Microphone
Sensitivity: −59 dB ref 1 mW/Nm^{-2}
Frequency Range: 200 to 4500 Hz
Noise Cancellation: 15 dB average
Output Impedance: 150 Ohms

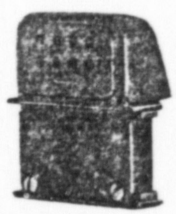


E. Model RN-1C

Carbon, Noise-Canceling Microphone
Sensitivity: −13 dB ref 1 mW/Nm^{-2} in 20 Ohm load
Frequency Range: 300 to 4000 Hz
Noise Cancellation: 18 dB average
Nominal Impedance: 30 Ohms

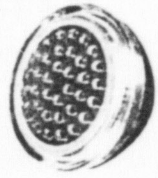
C. Model RBM-87

Dynamic, Noise-Canceling Microphone
Sensitivity: −72 dBM ref 1mW/Nm^{-2}
Frequency Range: 200 to 4000 Hz
Noise Cancellation: 17 dB average
Output Impedance: 5 Ohms



D. Model RM-6

Carbon, Noise-Canceling Microphone
Sensitivity: −14 dB ref 1 mW/Nm^{-2} in 100 Ohm load
Frequency Range: 300 to 4000 Hz
Noise Cancellation: 17 dB average
Nominal Impedance: 85 Ohms

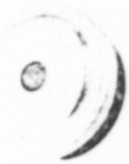


F. Model RN-1H

Carbon Microphone
Sensitivity: −8 dB ref 1 mW/Nm^{-2} in 20 Ohm load
Frequency Range: 300 to 4000 Hz
Noise Cancellation: None—pressure type microphone
Nominal Impedance: 40 Ohms

EARPHONE ELEMENTS

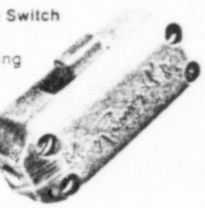
Model RE-200 Dynamic Earphone Element
Sensitivity: 105 dB
Frequency Range: 100 to 4500 Hz
Output Impedances: 20 Ohms, 150 Ohms, 300 Ohms



Model RE-300 Magnetic Earphone Element
Sensitivity: 118 dB
Frequency Range: 100 to 4300 Hz
Output Impedances: 5 Ohms, 20 Ohms, 150 Ohms, 300 Ohms, 600 Ohms, 1200 Ohms

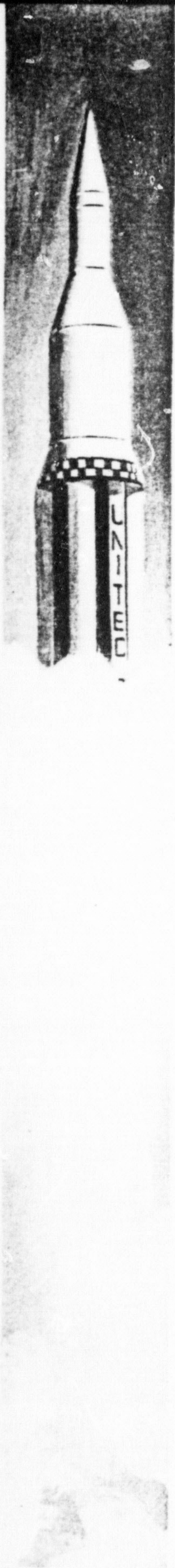
Model RH-143 Earphone Element
Sensitivity: 105 dB
Frequency Range: 100 to 5500 Hz
Output Impedance: 20 Ohms

Model RS-22 Miniature Switch Assembly
Available in the following standard actions:
A. Momentary Action, SPDT and DPDT
B. Locking Action, SPDT and DPDT



Note: Earphone sensitivity as measured at 1KHz, with standard 6 cc coupler, 1 mW available. Output is referred to .0002 dynes/cm².

(110) EP 0083



ROANWELL CORPORATION

Roanwell Building

180 Varick Street, New York, N. Y. 10014

Tel: (212) 989-1090 • TWX: 212-640-4791

LIGHTWEIGHT CORDAGE

Straight Cord supplied in customer specified lengths:

1. Vinyl (PVC) jacket, stranded, 2 conductor, no shielding.
2. Vinyl (PVC) jacket, stranded, 4 conductor, 2 shielded.
3. Vinyl (PVC) jacket, stranded, 6 conductor, 2 shielded.
4. Nylon braid jacket, stranded, 6 conductor, no shielding.

Retractile Cord supplied in 5 ft., 12 ft. and 20 ft. extended lengths:

1. Vinyl (PVC) jacket, stranded, 4 conductor, 2 shielded.
2. Vinyl (PVC) jacket, stranded, 6 conductor, 2 shielded.

TERMINATIONS

A. Connectors:
   - TP-120
   - U-174/U
   - 396-A
   - U-77/U
   - XLR(4)11
   - PJ-054
   - PJ-068
   - 91-MC-4M
   - 91-MC-6M

B. Tinned Leads

C. Spade Lugs

D. Clips

Transamps. Roanwell standard transistorized preamplifiers are available to match many standard circuits. Preamplifiers to match special circuit requirements can be supplied on a custom basis.

Roanwell Lightweight Headsets FAA Approved

FAA approval, Category A Usage, under TSO #'s C-57 and C-58, has been issued to the following:

Lightweight Headset, P/N 112390

Lightweight Headset Microphone Assemblies: P/N 108630, P/N 110160 and P/N 109740

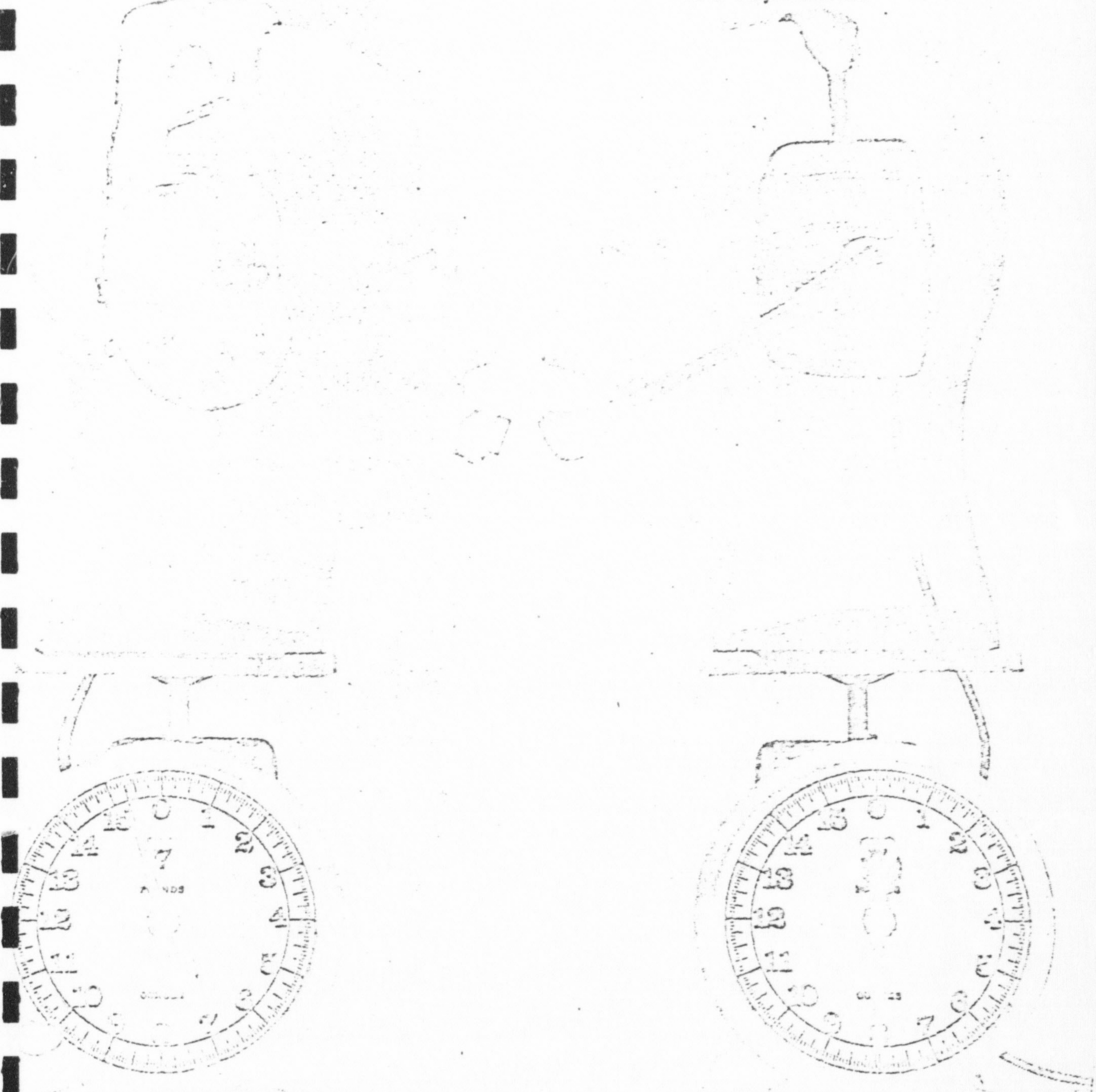
Applications

Telephone Operators
Telephone Linemen
Leak Detector Operators
Mobile Radio Operators
Base Station Operators
Radio & TV Broadcast Production
Commercial Jet Crews
Air Traffic Control
Private Aircraft Pilots
Airport Ground Crewmen
Missile Systems Crewmen
Rocket Launch Crewmen
Mine Detector Operators
Sonar Operators
Military Aircraft Crews
Ground Support Crewmen
Language Laboratories
Organ Consoles
Auditoriums
Home Use, HI-FI and TV

Printed in U.S.A. Catalog 1168

The headset you're wearing
weighs only 8 ounces?

Yes.
It's a Roanwell Lightweight.
It gives me more comfort
than ever before.
I can wear it longer
with less fatigue.
It's adjustable.



The heads weigh 7 lbs. The balance represents the weight of each headset.

Patented Oct. 18, 1949 2,485,405

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SPEECH PROJEC ON FROM MAN

"ACOUSTO"-ELECTRIC TRANSDUCER TYPE	COUPLING MEANS TO SOURCE	NOISE FIELD EXCLUSION
1. ELECTRODYNAMIC	1. AIR-EXTERNAL TO LIPS	1. PROXIMITY TO SOURCE
2. ELECTROMAGNETIC	2. PROBE TUBE TO AIR	2. NOISE SHIELD-OXYGEN MASK
3. RIN ARMATURE MAGNETIC	3. THROAT CONTACT	3. HELMET ENCLOSURE
4. BALANCED OR REED ARMATURE	4. LIP CONTACT	4. GRADIENT CANCELLATION
5. VARIABLE RESISTANCE-CARBON	5. TOOTH CONTACT	5. IMPEDANCE MISMATCH (RELATIVE SENSITIVITY TO AIR vs. SOLID TRANSMISSION)
6. PIEZOELECTRIC	6. AIR INSIDE MOUTH	6. HELMET WITH ACOUSTIC WINDOW WITH AUXILIARY NOISE SHIELD TO BE PLACED OVER WINDOW. ISOLATES BREATHING FROM MICROPHONE.
7. ELECTROSTATIC	7. EAR-DIRECT AIR	7. BAFFLE
8. MAGNETOSTRICTIVE	8. EAR-PROBE TUBE	8. TAILORING OF RESPONSE
9. ELECTRONIC	9. MECHANICAL COUPLING TO HEAD	9. CLIPPING IN TRANSDUCER
0. THERMISTOR BEAD	10. LIQUID COUPLING TO HEAD	10. DIRECTIONALITY OF MICROPHONE.
	11. AIR COUPLING TO HEAD	
	12. CHEST CONTACT	
	13. AIR-TURBULATOR IN BREATH STREAM TO ENHANCE CONSONANTS	
	14. ARTIFICIAL LARYNX TO INCREASE VOICE OUTPUT	

EVALUATION CRITERIA - (COMBINATION OF TRANSDUCER, COUPLER AND NOISE EXCLUDER)

1. NET EVALUATION OF INTELLIGIBILITY -- WORD ARTICULATION, NOISE-QUIET
2. PHYSICAL (DIAGNOSTIC) EVALUATION:
   - A. REAL VOICE FREQUENCY RESPONSE - DEFINES REQUIRED EQUALIZATION
   - B. DYNAMIC NOISE ATTENUATION
   - C. CONSONANT / VOWEL RATIO
   - D. SPEECH / DYNAMIC NOISE RATIO (CONSONANTS AND VOWELS)
   - E. SPEECH SOUND ALTERATION PROPERTIES

Ex. 27 113

2,485,405

F. BEHAVIOR WITH ALTITUDE

3. TAL..ER - LISTENER ACCEPTABILITY
   A. LISTENABILITY: NATURALNESS, PLEASANTNESS (LACK OF ANNOYANCE), SPEAKER RECOGNITION, DISCOMFORT AT HIGH LEVELS (SPEECH AREA UTILIZATION)
   B. WEARABILITY - DISCOMFORT
4. SIZE AND WEIGHT POTENTIAL

SPEECH RECEPTION TO MAN

ELECTRO-"ACOUSTIC" TRANSDUCER TYPE	COUPLING MEANS	NOISE FIELD EXCLUSION
1. ELECTRODYNAMIC	1. DIRECT (AIR CAVITY) TO EAR	1. OVER-EAR CUSHIO[N]
2. ELECTROMAGNETIC	2. PROBE TUBE TO EAR	2. SEMI-INSERT
3. RING ARMATURE MAGNETIC	3. AIR CAVITY TO HEAD SURFACE	3. FULL INSERT (HARVIN-TIP)
4. BALANCED OR REED ARMATURE	4. LIQUID COUPLING TO HEAD SURFACE	4. HELMET
5. PIEZOELECTRIC	5. MECHANICAL COUPLING TO HEAD SURFACE	5. EARPLUG UNDER CUSHION-MOUNTED RECEIVER
6. ELECTROSTATIC	6. DISTANT AIR COUPLING (LOUDSPEAKER)	6. ACTIVE ELEMENTS (ELECTRON[IC])
7. MAGNETOSTRICTIVE	7. LOUDSPEAKER IN HELMET - WITHOUT EAR SEAL	
8. IONOPHONE	8. LOUDSPEAKER OUTSIDE HELMET	
9. MODULATED AIR UNIT (MODULATE OXYGEN SUPPLY)	9. LOUDSPEAKER OUTSIDE HELMET WITH CAVITY COUPLING	
10. THERMOPHONE	10. MECHANICAL COUPLING TO HELMET	
11. ELECTROPHONICS		

EVALUATION CRITERIA

1. NET EVALUATION OF INTELLIGIBILITY -- WORD ARTICULATION, QUIET-NOISE
2. PHYSICAL EVALUATION:
   A. REAL EAR FREQ..NCY RESPONSE
   B. MAXIMUM SIGNAL LEVEL
   C. NOISE ATTENUATION
   D. MASKED THRESHOLD (COMBINES A AND C)
   E. SPEECH/NOISE RATIO
   F. BEHAVIOR WITH ALTITUDE
   G. SIGNAL SUPPLY REQUIREMENTS
3. TALKER-LISTENER ACCEPTABILITY
   A. LISTENABILITY
   B. WEARABILITY
4. SIZE AND WEIGHT POTENTIAL

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PLAINTIFF'S EXHIBIT 28

STUDY AND INVESTIGATION OF SPECIALIZED ELECTRO-ACOUSTIC TRANSDUCERS FOR VOICE COMMUNICATION IN AIRCRAFT

Contract AF33(616)-3710 -- FINAL REPORT

Task No. 43060

February 1959

WESTERN ELECTRO-ACOUSTIC LABORATORY, INC.

LOS ANGELES, CALIFORNIA

Ex. 28 115

2,485,405

STUDY AND INVESTIGATION

OF SPECIALIZED ELECTRO-ACOUSTIC

TRANSDUCERS FOR VOICE COMMUNICATION

IN AIRCRAFT

Contract AF33(616)-3710 – FINAL REPORT

Task No. 43060

February 1959

WESTERN ELECTRO-ACOUSTIC LABORATORY, INC.

Los Angeles, California

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From Fig. 25 and Kirchhoff's laws:

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Sec. Page

List of Tables and Charts

List of Figures

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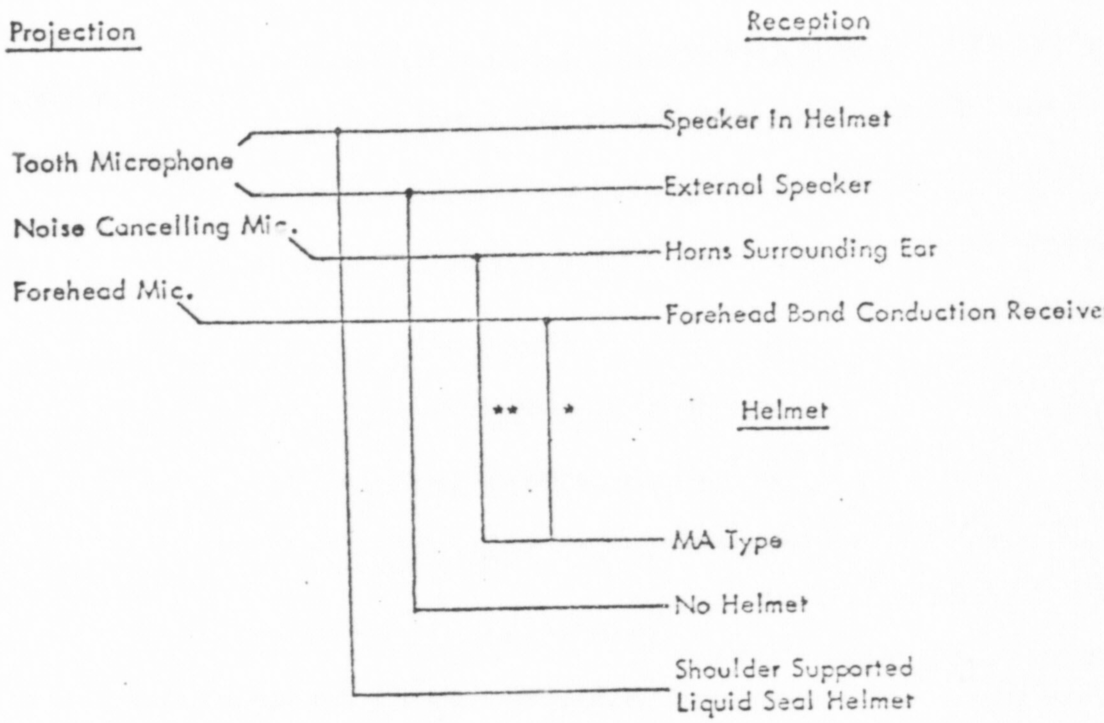
SYSTEMS RECOMMENDED FOR FUTURE

RESEARCH AND DEVELOPMENT



See Figures 1 through 8 for further description.

* Also could be used with shoulder supported type.
** Could be used in shoulder supported type providing the horns are supported by a liner or suitable mounting arrangement.

1. The tooth microphone could be used logically with all reception means and all helmets.

2. The noise-cancelling microphone could be used logically with all reception means and all helmets.

3. The forehead microphone could be used with all receivers, but because of its lower S/N it should be used with the shoulder-supported liquid seal helmet. It is most logically used as a reversible transducer, i.e. both as a microphone and bone conduction receiver.

TABLE I.

EXHIBIT
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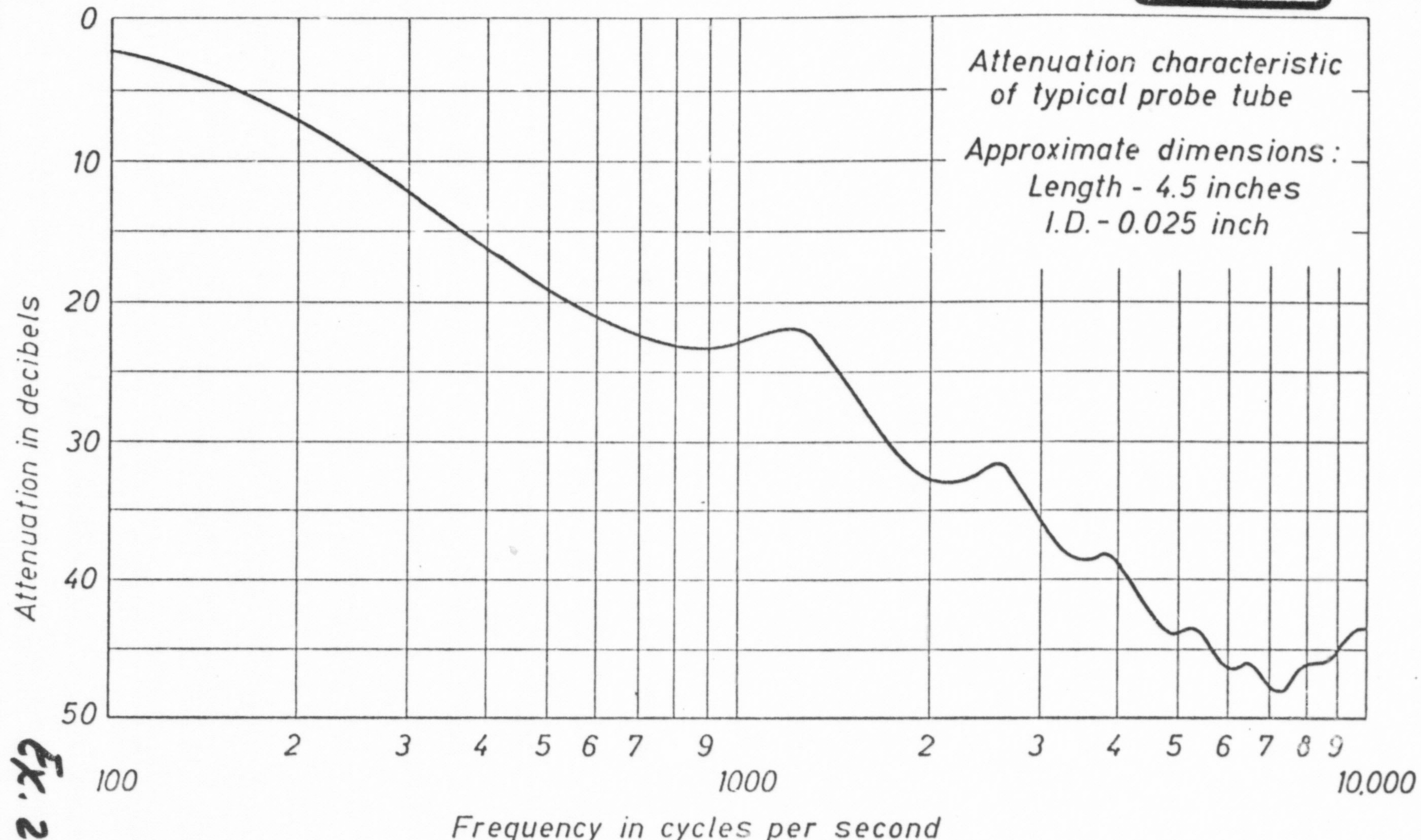

Ex. 29 (119)

Beranek FIG. 16 · 18

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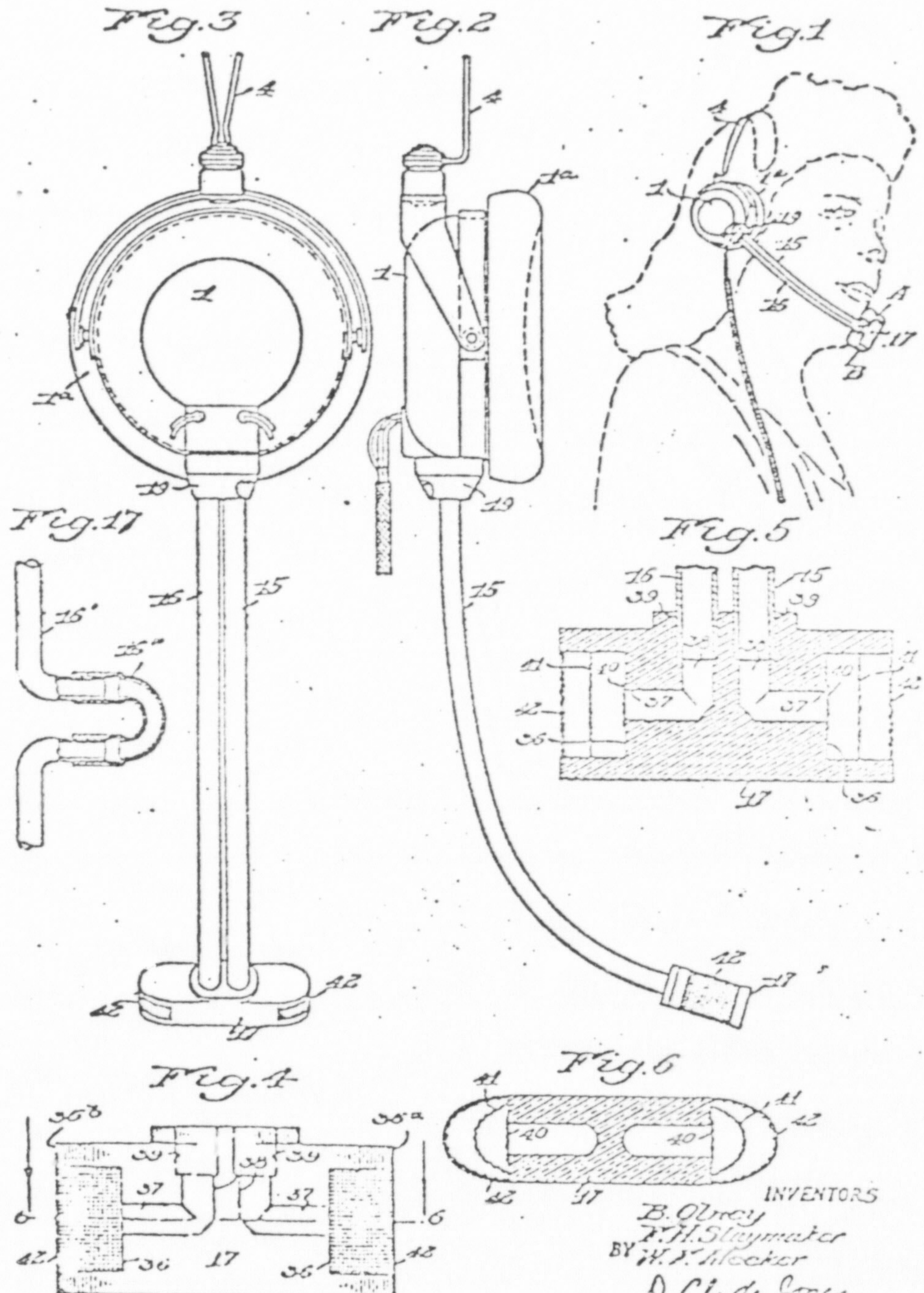
Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 1



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Ex. 30 (120)

Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 2

Fig. 7

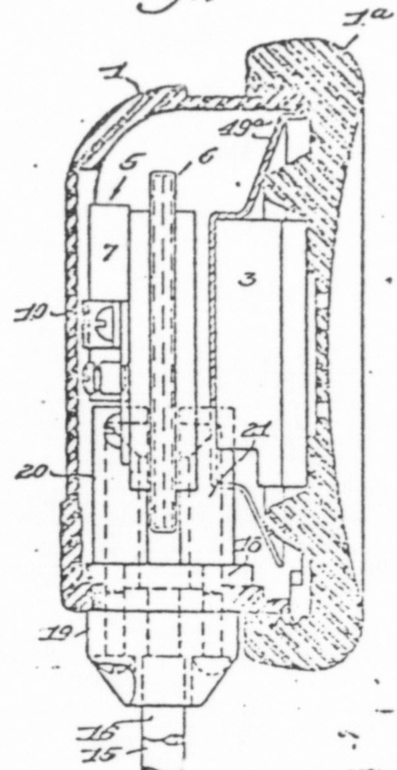


Fig. 10

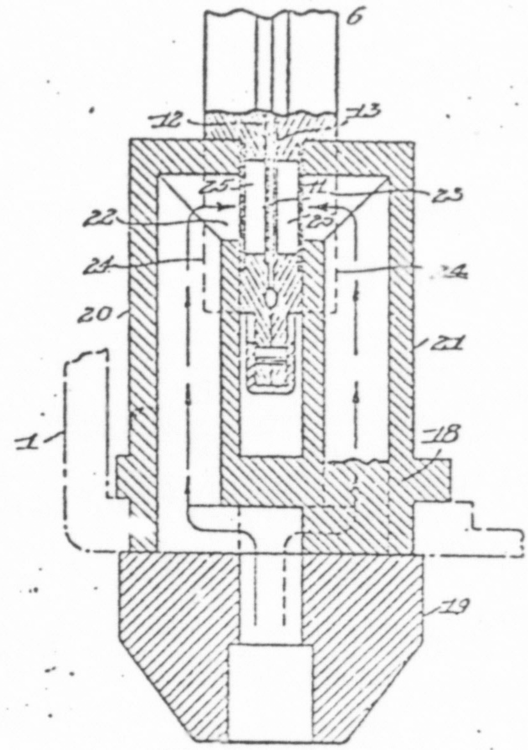


Fig. 16

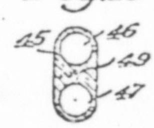


Fig. 8

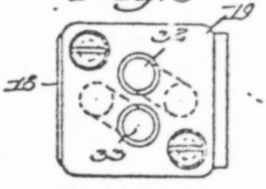


Fig. 15

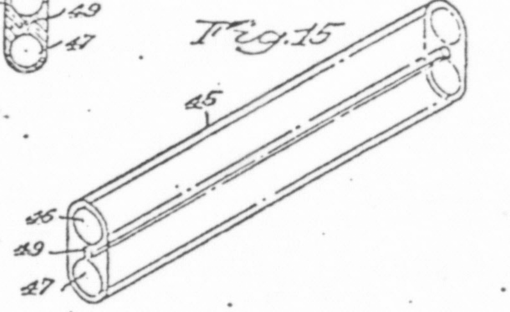
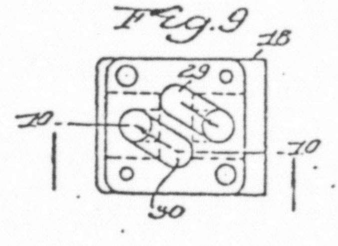


Fig. 9



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DIPOLE MICROPHONE

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Fig. 11

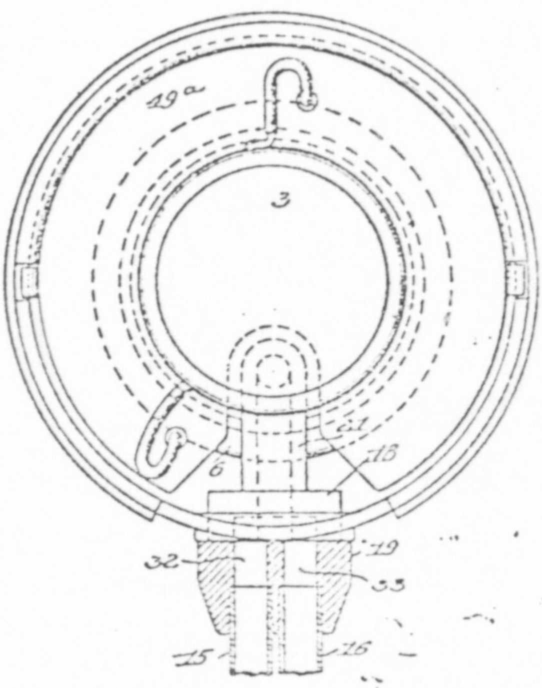


Fig. 12

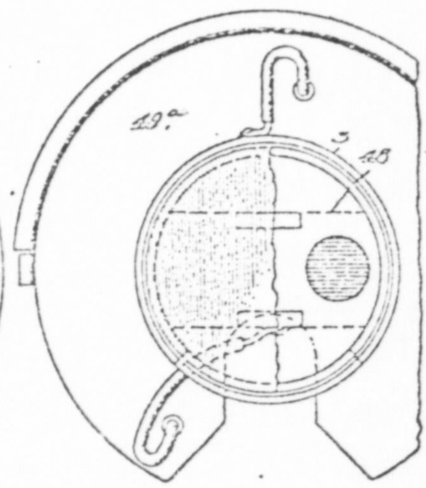


Fig. 13

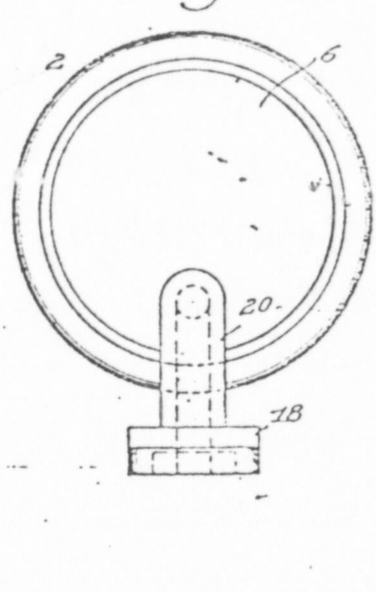
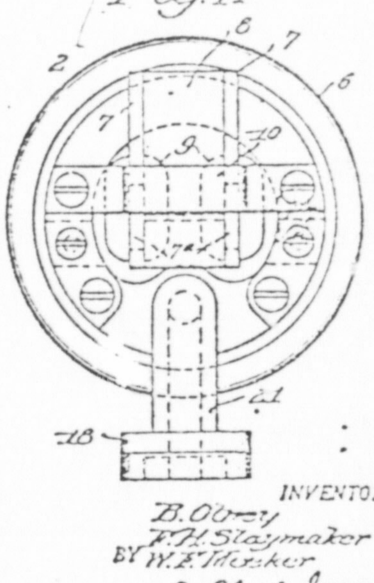


Fig. 14



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Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

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Fig. 19

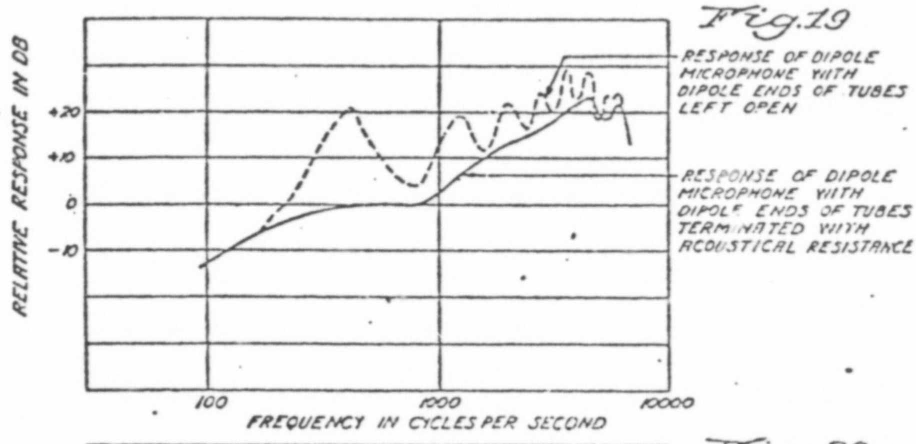


Fig. 20

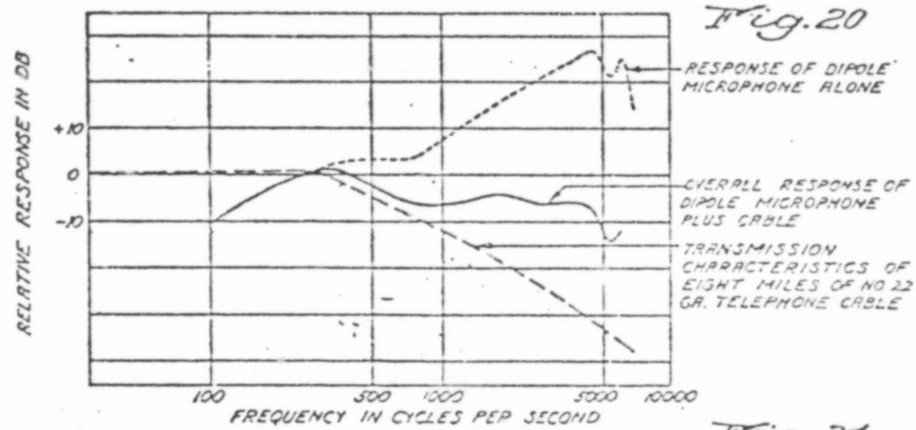


Fig. 21

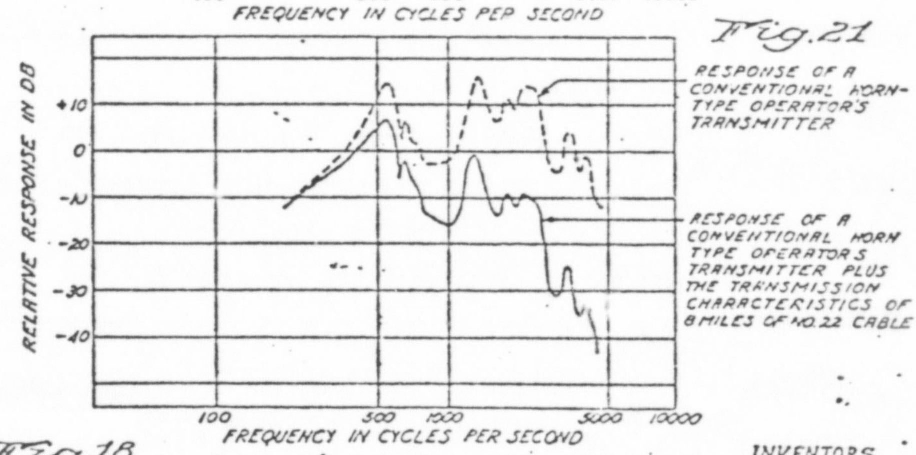
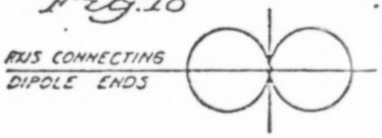


Fig. 18



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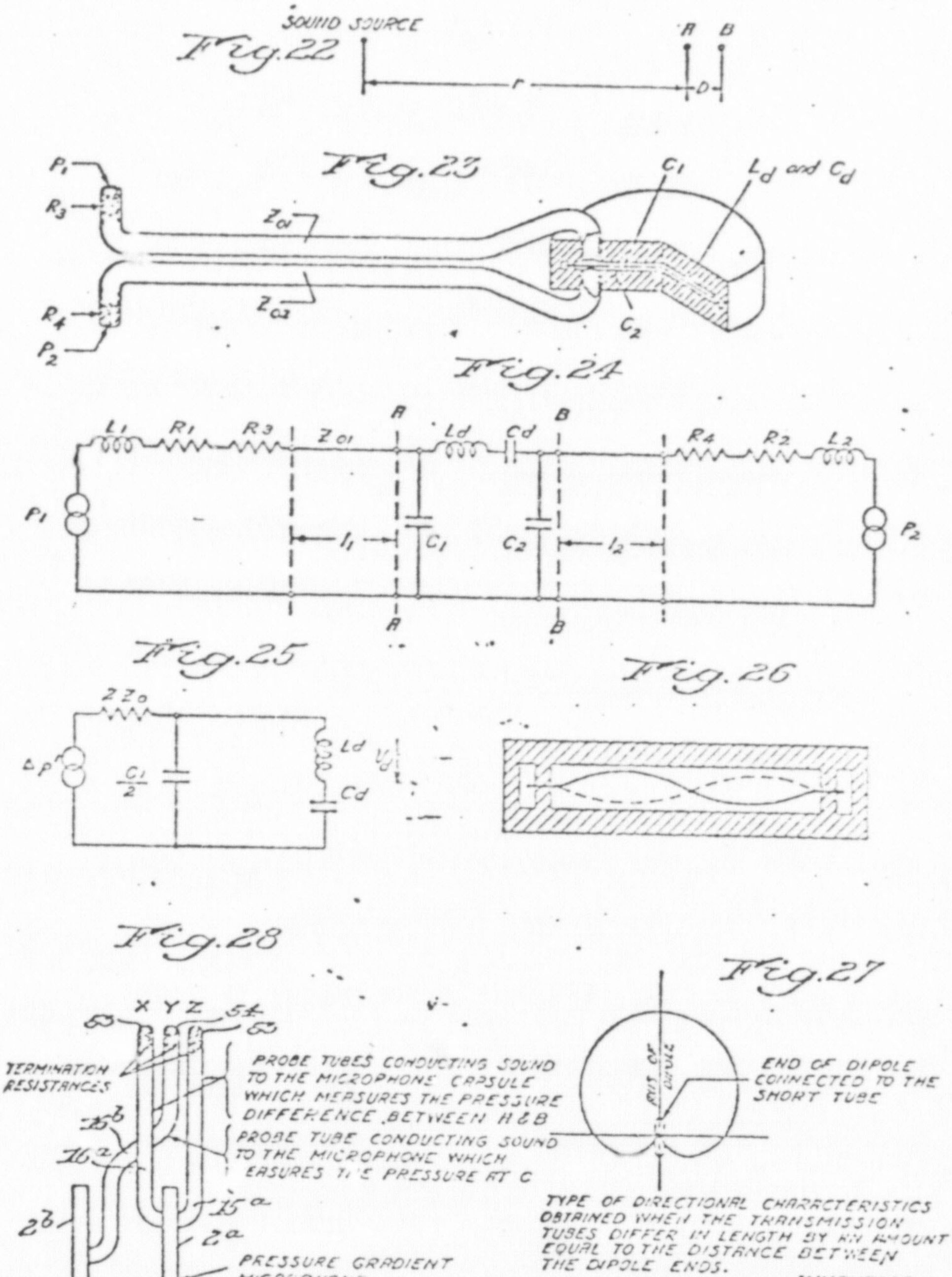
DIPOLE MICROPHONE

Filed April 21, 1944 6 Sheets-Sheet 5



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Oct. 18, 1949. B. OLNEY ET AL 2,485,405

DIPOLE MICROPHONE

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Fig. 29

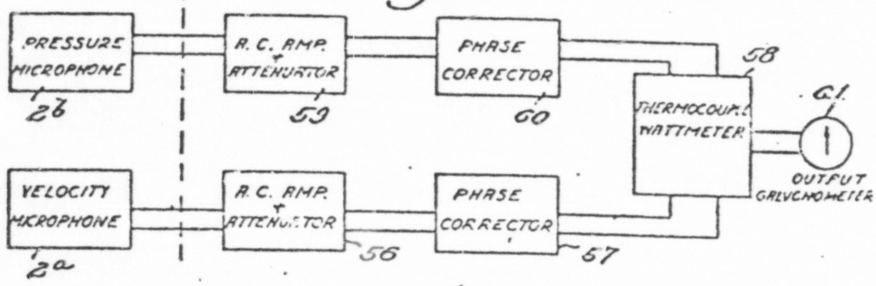


Fig. 30

X Y

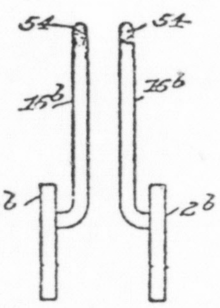
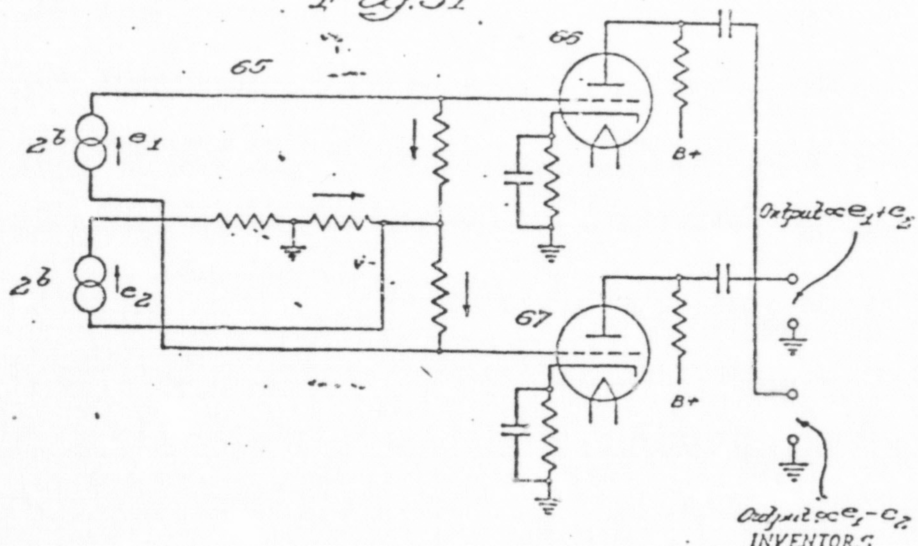


Fig. 31



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Patented Oct. 18, 1949 2,485,405

UNITED STATES PATENT OFFICE

2,485,405

DIPOLE MICROPHONE

Benjamin Olney, Frank H. Slaymaker, and Willard F. Meeker, Rochester, N. Y., assignors to Stromberg-Carlson Company, Rochester, N. Y., a corporation of New York

Application April 21, 1944, Serial No. 532,168

17 Claims. (Cl. 179—102)

1

This invention relates to electro-acoustical transducers and especially to microphones and to similar sound pickup devices.

In telephone transmitters, acoustical wattmeters, acoustical impedance meters and similar devices, there is involved the problem of picking up energy from sound waves and conveying or applying it to a unit which translates it into corresponding electrical effects.

In the case of telephone transmitters, it is frequently desirable that these devices discriminate against unwanted sounds. For example, in a telephone exchange, the noise at neighboring operators' positions should not be picked up by a given operator's transmitter. It would be an advantage if the transmitter were small so that it could be supported with the receiver against the operator's ear, thereby obviating the need for the usual chest-supported, horn-type microphone.

In an acoustical wattmeter or impedance meter, a suitable microphone unit or pickup device is essential in order to measure the energy being carried by sound waves. To determine sound intensity in a free field, it is merely necessary to measure the sound pressure, but in the presence of reflected waves, the relation of the pressure and particle velocity components of the waves may be disturbed so that the pressure alone is no longer a reliable indication of the sound intensity. Under such conditions, the sound intensity can be determined only if the pressure and velocity components of the wave, as well as the phase angle between them, are taken into account. However, relatively large microphone units or pickups cause difficulties at high frequencies since the microphone size and spacing is comparable to the wave length. However, the tube type or probe microphone construction of the present invention permits the pickup units to be made small enough so that they disturb the wave very little. Also, the tube units can be mounted close together so that the sound energy can be derived from a very small region.

The various features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which:

Fig. 1 is a perspective view of one embodiment of the invention wherein there is provided a com-

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bined receiver and dipole microphone adapted to be worn as shown;

Fig. 2 is a side view and Fig. 3 is a rear view of the telephone combination illustrated in Fig. 1;

Fig. 4 is a plan view of a mouthpiece suitable for use in this embodiment;

Fig. 5 is a vertical section through this mouthpiece;

Fig. 6 is a sectional view thereof, taken on the line 6, 6 of Fig. 4;

Fig. 7 illustrates that portion of the microphone and the receiver which is mounted within the casing or shell, the shell being broken away to illustrate the arrangement of the parts therein;

Fig. 8 is a bottom view of the junction block assembled on the bottom of the yoke;

Fig. 9 is a bottom view of the yoke alone;

Fig. 10 is a section taken substantially on the line 10, 10 of Fig. 9 showing the relation of the passages through the junction block and through the passages in the yoke as well as the respective cavities at each surface of the diaphragm mounted within the capsule;

Fig. 11 is an enlarged view of the elements mounted within the shell, particularly illustrating the microphone element and the receiver with the shield mounted between these parts and providing a support for the receiver;

Fig. 12 is a front view of a portion of the shield alone with the receiver mounted thereon;

Fig. 13 is a face view of the microphone unit with the yoke mounted thereon;

Fig. 14 is a similar view of the reverse side of the microphone and yoke;

Fig. 15 is a perspective view and Fig. 16 is a cross section through a modified form of tubing for connecting the mouthpiece with the microphone unit;

Fig. 17 illustrates a construction whereby the effective length of a tube connecting the mouthpiece to the microphone unit, can be adjusted;

Fig. 18 is a diagram illustrating the field of response of one embodiment of the pick-up unit of this invention;

Fig. 19 illustrates, by the broken line, the response of a dipole microphone with the dipole ends of the tubes left open while the [illegible] graph illustrates the response of the [illegible] microphone of the present invention when the dipole

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ends of the tubes are terminated with acoustical resistances;

Fig. 20 is a chart illustrating by the dotted line, the response of the present dipole microphone alone, and the broken line curve represents the transmission characteristic of eight miles of #22 telephone cable, while representing by the full line curve, the overall response of the present dipole microphone plus the mentioned cable;

Fig. 21 illustrates, by the broken line curve, the response of a conventional horn type operator's transmitter, while by the full line, it illustrates the response of the mentioned horn type transmitter plus the transmission characteristics of eight miles of #22 cable;

Figs. 22 to 26 inclusive are diagrams useful in explaining the principles of the invention;

Fig. 27 is a diagram useful in explaining the directional characteristics of the present dipole invention when tubes of different lengths are incorporated therein;

Fig. 28 is a diagrammatic showing of one type of microphone unit made in accordance with the present invention and suitable for use in an acoustical wattmeter or impedance meter;

Fig. 29 is a block diagram of an acoustical wattmeter or impedance meter incorporating the microphone or transducer unit of Fig. 28;

Fig. 30 is a diagrammatic showing of another type of microphone pickup of the present invention, likewise suitable for use in an acoustical wattmeter or impedance meter;

Fig. 31 is a circuit network which will be substituted for that portion of the meter of Fig. 29 at the left of the broken line thereof when the microphone pickup of Fig. 30 is used.

One embodiment of the invention, in the form of a dipole microphone of the pressure gradient type, is shown incorporated in an operator's telephone set in Figs. 1 to 17 inclusive. This telephone set comprises a shell 1 in which a microphone unit generally designated 2 and a telephone receiver 3 are enclosed, the shell with its enclosed parts being of a size and weight to be supported against the ear of the operator by means of a band 4 engaging the operator's head. The microphone unit may be any type of electro-acoustic transducer including a carbon or piezo-electric system. As herein illustrated, the microphone unit 2, preferably of the electromagnetic type, comprises an electromagnetic element 5 and the microphone capsule 6 of aluminum alloy on which this element is mounted. This electromagnetic element includes a pair of spaced pole pieces 7, 7 secured to the respective sides of a rectangular permanent magnet 8, these parts being retained in the position illustrated in Fig. 14 by a suitable brass clamp 10 secured to the capsule. Each pole piece has a part encircled by a coil 9, the two coils 9 being electrically connected in series for inclusion in a transmitter circuit (not shown). The extensions 7a, 7a (Fig. 14) of the two pole pieces just project through a wall of the capsule being sealed therein against air leakage. Thus, the extensions 7a, 7a of the pole pieces are positioned close to one surface of a diaphragm 11 within the capsule so that the electromagnetic element is influenced by the action of the diaphragm. Although this diaphragm is shown to be clamped in Fig. 10, it can be unclamped. The diaphragm defines the cavities 12 and 13 at the respective sides thereof, which cavities are proportioned to give adequate damping of the diaphragm resonance peak and to prevent a nodal diameter mode of vibration as will be further discussed hereinafter. The cavities 12 and 13 communicate through the tubes 15 and 16 respectively, which terminate in the mouthpiece 17 to be held adjacent the operator's mouth so that the usual horn type microphone can be dispens[ed] with. While the optimum internal diameters of the tubes 15 and 16 are related to the characteristics of diaphragm, in one model they measur[e] nine-sixty fourths of an inch. The specific co[n]struction which affords communication between the cavity 12 and tube 15 on the one hand and between cavity 13 and tube 16 on the other, [is] shown in Figs. 7 to 10 inclusive and comprises [a] yoke 18 together with a connection block 19. The yoke (Fig. 10) is made with two hollow branches 20 and 21 respectively provided with openings [22] and 23 in their respective inner surfaces. T[he] faces of the microphone capsule are milled out to provide recesses 24 having openings 25 and 26 into the cavities 12 and 13, the mentioned openin[gs] being preferably covered by dirt screens. Thu[s] the recesses in the microphone capsule can snugly receive the branches of the yoke with the openings 22 and 23 of the yoke respectively commu[ni]cating with the openings 25 and 26 through th[e] face walls of the capsule. The lower end of the yoke is provided with diagonally extending recesses 29 and 30 which communicate respective[ly] with the hollow passages through the yo[ke] branches. The connection block which can be assembled on the mentioned lower end of the yoke by suitable screws, has a pair of passag[es] 32 and 33 extending therethrough to open in the recesses 29 and 30 respectively. By this construction, the pair of passages through the block which are arranged in one plane can commu[ni]cate with the pair of yoke passages which are a[r]ranged in a plane extending at right angles [to] the first plane. The lower ends of these passages 32 and 33 are slightly enlarged to frictionally re[]ceive the upper ends of the tubes 15 and 16.

The dipole mouthpiece 17, as best shown [in] Figs. 4, 5 and 6 is preferably made of a block of light weight molded material having its ends 35a and 35b rounded, as illustrated. Each of th[e] rounded ends of the mouthpiece is notched as [at] 36 and has an opening 37 in the notched part communicating with a passageway 38. Each passageway 38 is formed with a bend leading to a[n] orifice 39 in one side of the block. It will be not[ed] that the two orifices 39, 39 are located close together and may detachably receive the free ends of the tubes 15 and 16.

Each opening 37 from the passageway into th[e] notched part of the mouthpiece is covered by a disc 40 of silk fabric secured at its margin by suitable adhesive to the surface of the mout[h]piece. The weave of the silk should be such [as] to provide the proper acoustic terminal impedance for the tubes 15 and 16, the purpose of which will be hereinafter set forth. Each notched e[nd] of the mouthpiece carries two curved pieces [41] and 42 of screening, such as wire gauze, the outer screen 42 conforming generally to its related rounded end of the mouthpiece. As illustrat[ed] in Fig. 1, the dipole mouthpiece is worn close [to] the lips, although this position is not critical, and consequently, in the absence of these screens 41 and 42, there would be serious blasting noises [in] the microphone due to the puffs of air acco[m]panying such sounds as "p" and "t." This double puff screen construction provides more effective reduction of puffing than a single screen and [in] addition enables the operator to [illegible] more and [illegible] ilize the outside screens without [illegible]posing the [illegible]

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minal resistances 40 to mechanical damage. Since the mouthpiece is intended to be worn with one end of the dipole relatively close to the lips and the other dipole end directed toward the chin, the tubes 15 and 16 are preferably made of some shape-retaining deformable material which may be, for example, a thermo-plastic material, such as that now known as "Saran," so that the tubes can be generally shaped to the contour of the operator's face whereby the mouthpiece will be properly located with respect to the operator's mouth when the telephone receiver is supported in contact with one of her ears, as shown.

Instead of using two separate tubes, such as 15 and 16, a single strip of relatively soft material 45 (Figs. 15 and 16) having two passages 46 and 47 therethrough may be used, when the openings in the yoke and in the mouthpiece are modified to receive the respective ends of the strip. In this modification, the strip has a wire 48 incorporated therein which tends to cause the strip to remain in the position to which it has been bent in the course of being adjusted to the head of an operator.

Under certain conditions it may be desirable to modify the directional characteristics of the microphone and for this purpose at least one of the tubes 15 and 16 may be arranged so that its effective length can be adjusted at will. For example, the tube 16' (Fig. 17) is provided with a telescoping crook 16'' similar to a tuning slide on a trumpet.

The telephone receiver 3 may be any light weight watch case receiver of small size. One flat side of the receiver is provided with an opening to allow room for the yoke 18 to be assembled on the capsule 6 when the microphone 2 and the receiver 3 are compactly arranged as shown with the microphone magnet 8 at right angles to the receiver magnet 43 and its related pole pieces. A magnetic shield 49a is mounted between the microphone and the receiver to prevent disturbing action therebetween. This shield also serves as a mechanical support for holding the receiver against the ear cap 1c of the shell.

A dipole microphone may be defined as one whose sound pickup elements are arranged in the form of an acoustic dipole, and are differentially associated with the transducer element. Such a microphone responds to a sound wave, only if there is a difference in pressure between the dipole ends 35a and 35b (Fig. 4). A sound originating in the plane midway between A and B, for example, would produce no pressure difference and, hence, no microphone response. The directional characteristics of the dipole microphone are shown in Fig. 18. When the microphone is worn as shown in Fig. 1, the plane of minimum response includes sounds originating at each side of the operator, and also sounds coming from in front of and somewhat below the operator's head. Thus the microphone can be oriented so as to discriminate against the voices of the adjacent operators and the clattering of plugs on the switchboard, and yet be in a position to give maximum response to the voice of the wearer.

Even in the direction of its maximum response, the dipole microphone discriminates against distant sounds—especially sounds of low frequency. This is of benefit in many locations where rumbling noises are troublesome. The explanation is as follows: when the microphone is worn with one end of the dipole close to the lips, sounds issuing from the wearer's mouth give rise to am-

plitude, as well as phase differences at the dipole ends. For sounds arriving from a distance, however, there is substantially no amplitude difference at the dipole ends. Consequently, the response in this latter case is due almost entirely to phase difference. As the wave length of the received sound becomes longer, the distance between the dipole ends constitutes a smaller and smaller proportion of the wave length. Thus, the phase difference becomes progressively smaller for lower frequencies. It is this fact which accounts for the discrimination mentioned above.

A further substantial gain in signal-to-room-noise ratio over the conventional breastplate transmitter is obtained because of the close location of the dipole to the lips. This location is fixed, whereas the corresponding relation in the case of the breastplate transmitter varies as to angle and distance with the movements of the wearer's head.

A still further advantage of the dipole microphone in noisy locations is its freedom from resonant peaks, as compared with strong resonances of the usual breastplate transmitter horn. These latter resonances are shock-excited by certain of the noise components, and the noise is effectively amplified in the process.

The use of tubes, such as 15 and 16, constitute an acoustic transmission line for the conduction of sound from the dipole mouthpiece to the microphone unit proper (located in the receiver case), makes it possible to eliminate the large horn traditionally associated with operator's sets. The inherent presence of standing waves in tubes 15 and 16 has, in the past, prevented the use of a microphone employing a small number of tubes where reasonably faithful reproduction was desired. In the present dipole microphone, however, a termination resistance 40 at the dipole end of each tube matches the acoustic impedance of the tube and eliminates the effect of the standing waves. Fig. 19 shows (solid line curve) the normal frequency response of this microphone and, for purposes of comparison, the response (dotted line curve) with the terminating resistance removed. It will be noted that the normal response of the microphone rises 6 db per octave toward the high frequencies. This type of response compensates for the drooping transmission characteristic of unloaded cable circuits. Fig. 20 shows the transmission characteristic of eight miles of No. 22 cable and the overall response of the cable and microphone. For comparison, Fig. 21 shows the response of the conventional horn type operator's set.

Fundamental theory

The principles of the invention will best be understood by reference to Figs. 17 to 22 together with the following analysis. The pressure at a distance r from a point source of sound can be expressed by

$$p=\frac{A\omega\rho}{r}\sin k(ct-r) \qquad (1)$$

where:

p=the sound pressure at the point in questions.
A=the amplitude of the velocity potential.
ρ=the density of the medium.
r=the distance from the point source to the point in question.
$\omega=2\pi f$, where f is the frequency.
c=velocity of sound in the medium.
t=time.
$k=2\pi/\lambda$, where λ=the wave length of the sound wave.

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The difference in pressure between two points A and B separated by a distance D (Fig. 22) is given by the following expression:

$$\Delta p = A\omega\rho\left[\frac{\sin k(ct-r)}{r} - \frac{\sin k(ct-r-D)}{r+D}\right] \qquad (2)$$

Two extreme conditions are of interest in practice. One is for sounds originating at a distance from the microphone; i. e., r is large compared to D. The other is for sounds originating very close to the microphone; i. e., r is small compared to D. Also, in general, D is small compared to the wave length, and kD is small compared to unity. If r is large and kD is small, Equation 2 becomes

$$\Delta p \doteq kD\frac{A\omega\rho}{r}\cos k\left(ct-r-\frac{D}{2}\right) \qquad (3)$$

Equation 3 shows that for a sound arriving from a distance, $|\Delta p|$ is smaller than the pressure at A by a factor kD. If r is small compared to D, Equation 2 becomes

$$\Delta p \doteq \frac{A\omega\rho}{r}\sin k(ct-r) \qquad (4)$$

A comparison between Equation 1 and Equation 4 shows that Δp is approximately the same as the pressure at point A. If, however, the sound source is located on the median plane between points A and B, there is no resultant difference in pressure between the two points.

A pressure gradient microphone close to the source

When a pressure gradient micrphone is used close to the source, it becomes an instrument which discriminates very powerfully against sounds arriving from a distance ("a distance" being merely a few feet for voice frequencies). The factors responsible for this discrimination can be summarized as follows:

1. For sound arriving from a distance, the pressure gradient (strictly a pressure increment) is smaller than the sound pressure by a factor kD—a reduction which is especially apparent at low frequencies.

2. Sound which appears to originate in a plane midway between points A and B (see Fig. 1 and Fig. 22) produces no difference in pressure between the points and no response in the microphone.

3. A sound close to the microphone will, inherently, produce a greater response than a sound which is far away.

Analysis and factors affecting the frequency response of the dipole microphone

The factors affecting the response of a dipole microphone will best be understood by reference to Figs. 23, 24 and 25. Fig. 23 is a diagrammatic representation of the acoustic elements and the diaphragm of a dipole microphone. Fig. 24 shows the analogous electrical circuit corresponding to Fig. 23; and Fig. 25 is a simplification of Fig. 24. A list of symbols pertaining to the above three figures is given below:

p_1=sound pressure at one end of the dipole.
p_2=sound pressure at the other end of the dipole.
L_1=acoustic inertance due to radiation from the end of one tube.
L_2=acoustic inertance due to radiation from the end of the other tube.
R_1=acoustic resistance due to radiation from the end of one tube.

R_2=acoustic resistance due to radiation from the end of the other tube.
R_3=acoustic resistance inserted to terminate one tube
R_4=acoustic resistance inserted to terminate the other tube.
Z_{01}=characteristic acoustic impedance of the first tube=$\rho c/s_1$.

Where:

ρ=density of the medium.
c=velocity of sound in the medium.
s_1=cross-sectional area of the first tube.
Z_{02}=characteristic acoustic impedance of the second tube=$\rho c/s_2$.

Where:

s_2=the cross-sectional area of the second tube.
C_1=acoustic compliance of the cavity on the first side of the diaphragm.
C_2=acoustic compliance of the cavity on the other side of the diaphragm.
L_d=mass of the diaphragm (in consistent units).
C_d=compliance of the diaphragm (in consistent units).
v_d=diaphragm velocity (in consistent units).
l_1=length of the first tube.
l_2=length of the second tube.

Any type of transducer may be used to convert the diaphragm motion into electrical energy, but for the purposes of analysis it will be assumed that the transducer is some sort of an electromagnetic element which generates an E. M. F. proportional to the diaphragm velocity (v_d). Although it would be possible to derive a general expression for v_d in terms of p_1 and p_2 and all the circuit constants, the inherent symmetry of the microphone and the relative magnitudes of the end effects compared to the characteristic impedance of the respective tubes make possible considerable simplification. In practice, $C_1=C_2$, $l_1=l_2$, $Z_{01}=Z_{02}=R_3=R_4$, $R_1=R_2$, and $L_1=L_2$. Also $|R_1+j\omega L_1| \ll Z_{01}$, so R_1 and L_1 can be neglected. It follows, then, that looking back toward the generator from either AA or BB, the tube being considered is, in effect, a transmission line excited from a source having an internal impedance equal to the characteristic impedance of the tube. The impedance looking back from AA or BB is also equal to the characteristic impedance of the tube. From Thevenin's theorem and Kirchhoff's laws it can be shown that the circuit of Fig. 25, insofar as v_d is concerned, is the equivalent of the circuit in Fig. 24.

$\Delta p'$ in Fig. 25 is the difference in the "open circuit pressures" at AA and BB in Fig. 8. Z_0 is used instead of either Z_{01} or Z_{02} since the two are equal. If losses in the transmission tubes are neglected, it can be shown, from transmission line theory, that

$$\Delta p' = \frac{-j\Delta p}{\sin kl_1 - j\cos kl_1}$$

where Δp is the difference in pressure between p_1 and p_2. It will be noted that

$$|\Delta p| = |\Delta p'|$$

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and the only effect of the tubes is to introduce a phase shift. If the ends of the tubes had been left open and R_3 and R_4 eliminated the tube impedance viewed from AA or BB would be either inductively or capacitatively reactive, and v_d would show sharp resonance peaks.

From Fig. 25 and Kirchhoff's laws:

$$v_d = \frac{\Delta p \frac{1}{j\omega C_1}}{\left(j\omega L_d + \frac{1}{j\omega C_d}\right)\left(Z_0 + \frac{1}{j\omega C_1}\right) + \frac{2Z_0}{j\omega C_1}} \frac{-j}{\sin ki_1 - j\cos ki_1} \quad (6)$$

For low frequencies such that

$$\frac{1}{j\omega C_1} \gg Z_0 \text{ and } \frac{1}{j\omega C_d} \gg Z_0$$

$$|v_d| \doteq \Delta p \omega C_d \quad (7)$$

That is to say, the diaphragm velocity is independent of Z_0 and C_1. If Δp is constant, v_d is proportional to the frequency. Equations 4 and 3 show that, close to the source, Δp is approximately the same as the pressure while at a distance from the source Δp is proportional to k and rises directly with the frequency. Close to the source, then

$$v_d \propto \omega p \quad (8)$$

And at a distance

$$v_d \propto \omega^2 p \quad (9)$$

At higher frequencies the total "current" through the tubes is limited by $2Z_0$, but the possible existence of resonance involving $C_1/2$, L_d, C_d may allow v_d to rise to a far higher value than the total "current" through the tubes. If C_1 is so small it can be neglected, and the frequency is such that the diaphragm impedance is small compared to $2Z_0$,

$$|v_d| \doteq \Delta p / 2Z_0 \quad (10)$$

and is independent of both C_d and C_1.

Close to the source

$$v_d \propto p \quad (11)$$

And at a distance

$$v_d \propto \omega p \quad (12)$$

When C_1 is small, the diaphragm velocity is limited by $2Z_0$ even at diaphragm resonance. Hence, the diaphragm resonance peak may be controlled by adjusting C_1. If C_1 is large enough that it is significant and the diaphragm resonance is so high that L_d is not significant.

$$|v_d| \doteq \frac{\Delta p}{Z_0\left(\frac{C_1}{C_d} + 2\right)} \quad (13)$$

which shows that v_d may depend upon the ratio of C_1 to C_d, as well as, the value of Z_0.

At frequencies above diaphragm resonance it is more difficult to predict the performance of the microphone, since instead of vibrating as a whole the diaphragm tends to vibrate in sections. It is possible, however, to control the mode of vibration of the diaphragm, to some extent, by adjusting the size and shape of C_1. The first mode of vibration above the fundamental occurs when the diaphragm vibrates with one nodal diameter, as shown in Fig. 26.

If the cavities on each side of the diaphragm are shallow, the air is pumped back and forth in the cavities in a manner similar to pumping air through slits. The shallow cavities present considerable resistance to the flow of air. It is possible, in practice, to make the cavities sufficiently shallow to suppress, by the coupled acoustic resistance, the one nodal diameter mode of vibration entirely.

As referred to above, in the case of plane waves, the directional characteristics of the normal dipole microphone show the "figure 8" shape like all pressure gradient microphones. The pattern can be changed to a cardioid shape (Fig. 27) or any shape intermediate the two as shown on page 210 in "Elements of Acoustical Engineering," published by D. Van Nostrand Co., Inc. This change can be effected by altering the length of one tube with respect to the other. If one tube is longer than the other by a length equal to the distance between the ends of the dipole, the directional pattern will be a cardioid provided losses in the tubes can be ignored. Strictly speaking, the cardioid pattern is obtained only with sounds originating at a distance from the microphone. For sounds originating close to the microphone there is a difference in pressure amplitude between the two ends of the dipole which prevents complete cancellation in the minimum response direction. If, however, the sensitivity of one side of the microphone is altered (by increasing the losses in one of the tubes), it is possible to make a microphone with zero response for sounds arriving from a definite direction and distance. Consider a dipole microphone in which the absolute ratio of sound pressure at the ends of the dipole must be

$$|p_1/p_2|$$

for the pressure on each side of the diaphragm to be equal. Let us suppose, also, that the sound source is located on a line connecting the two ends of the dipole, and that the lengths of the tubes are such that the pressures on both sides of the diaphragm are in phase. Under the assumed conditions, there would be no response to the sound wave. To find the distance from the sound source to the microphone for complete cancellation to take place, let us write:

$$p = {}^1/_r S_0$$

From Equation 1

$$p_1/p_2 = r/(r+D)$$
$$r = D/(p_2/p_1 - 1) \quad (14)$$

It is possible, then, to construct a microphone which will not respond to sounds originating at a certain spot. A similar adjustment of the sensitivity of either side of the microphone can be applied when the microphone is adjusted for directional patterns between "figure 8" and cardiod, but not when the pattern is a normal "figure 8."

Other modifications of the invention

While the invention has been disclosed above as a double tube or dipole microphone, it can be adapted to a single tube microphone by omitting the mouthpiece 17 and either one of the tubes 15 or 16 (Fig. 3). It will be understood, of course, that the retained tube, such as 16, will have its free end treated with a suitable terminal resistance which may be silk fabric, such as 40 (Fig. 6), or which may be a tuft of cotton or the like inserted therein and that the acoustic impedance associated with the other side of the diaphragm will be made suitably low preferably by increasing the size of the cavity back of the diaphragm. Such a microphone may be used in a combined telephone set similar to that of Fig. 1 when the noise-cancelling feature is not necessary.

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The single tube unit which functions as a pressure microphone may also be combined with

a pressure gradient microphone to provide a combination pressure and velocity responsive pick-up device (Fig. 28) for use in an acoustical wattmeter or in an impedance meter. While this pickup device is shown diagrammatically, the pressure gradient microphone portion thereof, with the exception of the mouthpiece, may be identical with the microphone illustrated in Figs. 1 to 16 inclusive and corresponding parts are designated by the same reference characters with the letter "a" added thereto. The free ends of the tubes 15a and 16a are each provided with a suitable terminal acoustic resistance designated 53. The pressure microphone comprises the microphone element 2b, which may be similar to that described, communicates with the tube 16b provided at its free end with a suitable terminal resistance such as an insert of cotton 54 or it may be in the form of a silk fabric covering, such as previously mentioned. The free ends of the tubes 15a, 16a and 16b which serve as probe tubes are arranged close together with the end of probe tube 16b located between the other two.

As long as the distance between points X and Z at the free ends of the dipole tubes is small compared to the wave length of sound being measured, the pressure difference between X and Z is proportional, both in phase and amplitude, to the particle velocity at a third point Y between the first two. If the pressure is also measured at Y, we have enough information to obtain either the specific acoustic impedance which is the complex ratio of pressure divided by the particle velocity, or the acoustic power passing the ends of the probe tubes, which is the real part of the complex product of pressure and particle velocity.

The pressure gradient microphone, then, gives a voltage which is proportional in amplitude to the particle velocity of the sound wave, while the pressure microphone gives a voltage which is proportional in amplitude to the pressure. If the total phase shift from the ends of the dipole tubes to the output terminals of the pressure gradient microphone is the same as the total phase shift from the end of the single tube to the output terminals of the pressure microphone, the phase difference between the two voltages is the same as the phase difference between the particle velocity and the pressure components of the sound wave. When the two voltages, just mentioned, have been thus developed, they can be introduced into appropriate electronic circuits and the complete assembly may be referred to as an acoustical wattmeter or impedance meter to give either the power or the impedance.

The acoustical wattmeter or impedance meter may be somewhat similar to that disclosed by Clapp and Firestone in the Journal of the Acoustical Society of America, issue of October, 1941, pages 125 and 126. In Fig. 29, there is shown a simplified block diagram of such a meter. In this diagram, the output of the velocity microphone 2a is connected to an alternating current amplifier and attenuator unit 56. The output of this unit is coupled to a phase corrector 57 which in turn is coupled to a thermocouple wattmeter 58. The output of the pressure microphone 2b of the pickup shown in Fig. 28 is likewise connected to an alternating current amplifier and attenuator unit 59. The output of this unit is coupled to a phase corrector 60 which in turn is also linked to the thermocouple wattmeter 58. The output of this thermocouple is delivered to an output galvanometer 61 which is calibrated in watts per square centimeter of sound power passing the pickup. It should be pointed out that if the microphone units 2a and 2b are suitably matched, the phase correctors 57 and 60, can be omitted.

Another form of pickup device for use in an acoustical impedance meter or wattmeter, is illustrated in Fig. 30 wherein two pressure microphones, each having the parts 2b, 16b and 54, are mounted to have the free ends of the probe tubes 16b close together. With the pickup device just described, the pressure can be measured by taking the complex sum of the voltages from the two microphones 2b and the pressure gradient (or velocity) can be measured by taking the difference between these voltages.

The pickup device, comprising the microphones 2b, 2b (Fig. 30), can be utilized in the meter of Fig. 29, when the bridge network 65, together with the pair of vacuum tubes 66 and 67 of Fig. 31, are substituted for the portion of the diagram at the left of the broken line in Fig. 29. The vacuum tubes 66 and 67 can be dispensed with, if the input impedance to amplifiers 56 and 59 (Fig. 29) is high.

What we claim is:

1. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber, an electrical element influenced by said diaphragm, a tube of substantial length for conveying sound pressure to said chamber and communicating at one end with said chamber, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, and means only at said other end of said tube for substantially eliminating the effect of standing waves therein.

2. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber, an electrical element influenced by said diaphragm, a tube of substantial length for conveying sound pressure to said chamber and communicating at one end with said chamber, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, means only at said other end of said tube for substantially eliminating the effect of standing waves in said tube and a puff screen covering the other end of said tube.

3. In a telephone set, a microphone adapted to be supported adjacent the ear of the user, and a tube adapted to extend from the microphone to a point adjacent the mouth of the user whereby sound is conveyed to the microphone, the end of said tube adjacent the mouth of the user being provided with means for substantially eliminating the effect of standing waves therein.

4. In a telephone set, a microphone adapted to be supported adjacent the ear of the user, a tube of a length to extend from the microphone to a point adjacent the mouth of the user whereby sound is conveyed to the microphone, the end portion of the tube adjacent the mouth of the user having means thereat for substantially eliminating the effect of standing waves in said tube, and a puff screen substantially covering the last-mentioned end of said tube.

5. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with a pair of tubular passages, one passage communicating at one end thereof with one of said chambers

one end of the other passage communicating with the other chamber, the distance between the remaining ends of said passages being small compared to the wavelength of the desired sounds to be received and disposed for picking up sounds to be communicated to said diaphragm, and means only at said remaining ends for substantially eliminating the effect of standing waves in said passages.

6. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with only a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, the distance between the remaining ends of said passages being small compared to the wavelength of the desired sounds to be received and disposed for picking up sounds to be communicated to said diaphragm, means only at said remaining ends for substantially eliminating the effect of standing waves in said passages and puff screens covering the last-mentioned ends of said passages.

7. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, and means having long slender passages respectively communicating with said chambers and adapted to terminate at spaced points adjacent the mouth of the user.

8. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, means having long slender passages respectively communicating with said chambers and adapted to terminate at spaced points adjacent the mouth of the user, and means substantially eliminating the effect of standing waves in said passages.

9. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case, a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber at each side of said diaphragm, said diaphragm serving to influence the electrical means of said microphone, means having long slender passages communicating with said chambers and adapted to have their free ends terminate at spaced points adjacent the mouth of the user, means substantially eliminating the effect of standing waves in said passages, and puff screening covering the free ends of said passages.

10. In a combined transmitter and receiver unit adapted to be supported adjacent the ear of the user, a case having a microphone element and a receiver element mounted therein, a magnetic shield positioned between said elements, each of said elements having means developing a magnetic field, the magnetic means of one element being positioned at substantially right angles to that of the other, the microphone element comprising a capsule, a diaphragm cooperating with said capsule to define a chamber, said diaphragm serving to influence the electrical means of said microphone, and a tube having a long slender passage communicating with said chamber and adapted to terminate at a point adjacent the mouth of the user, said tube being made of a material adapting it to be shaped to the face of the user.

11. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, a pair of tubes having two of their ends respectively communicating with said chambers, means for changing the effective length of at least one of said tubes, the other end of said tube being disposed for picking up sounds to be communicated to said diaphragm, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said tubes.

12. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, and a mouthpiece comprising an elongated block having a pair of side openings therein respectively communicating with the remaining ends of said passages, said side openings respectively communicating with an opening in each end of said block, said block being supported during use with one end opening therein directed toward the wearer's mouth and the other end opening therein being directed away from wearer's mouth.

13. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means provided with a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, a mouthpiece comprising an elongated block having a pair of side openings therein respectively communicating with the remaining ends of said passages, said side openings respectively communicating with an opening in each end of said block, said block being supported during use with one end opening therein directed toward the wearer's mouth and the other end opening therein being directed away from wearer's mouth, and pieces of porous material, such as silk, providing acoustical impedance at said end openings.

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14. In a sound pick-up device, a microphone comprising a hollow capsule divided by a diaphragm into two chambers, electrical means arranged to be influenced by said diaphragm, tubular means having two passages respectively communicating at one end with said chambers, said tubular means having the free end thereof terminating at a position remote from said chambers with the free ends of said passages spaced a small distance apart compared to the wavelength of the desired sound being measured, and a second microphone comprising a diaphragm and electrical means to be influenced thereby, a tube having one end communicating with said last-mentioned diaphragm and having its other or free end terminating between the free ends of said passages, means for substantially eliminating the effect of standing waves in said tube and in said passages, and means for combining the responses of said microphones.

15. In a sound pick-up device, a pair of microphones each provided with a probe-like tube to communicate sound effects to its respective microphone, the exposed ends of said tubes terminating close together, means only at said exposed ends for substantially eliminating the effect of standing waves in said tubes, and means for combining the responses of said microphones.

16. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means providing a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and the other passage communicating at one end thereof with the other of said chambers, the distance between the other ends of said passages being small compared to the wavelength of the desired sounds to be received, means for varying the length of one of said passages, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said passages.

17. In a transducer, a microphone unit including a diaphragm cooperating with portions of said unit to define a chamber at each side of said diaphragm, electrical means influenced by said diaphragm, means providing a pair of tubular passages, one passage communicating at one end thereof with one of said chambers and one end of the other passage communicating with the other chamber, the distance between the other ends of said passages being small compared to the wavelength of the desired sounds to be received, one of said passages being longer than the other of said passages by a length equal to the spacing between said other ends of said passages, and means only at said other ends of said tubes for substantially eliminating the effect of standing waves in said passages.

BENJAMIN OLNEY.
FRANK H. SLAYMAKER.
WILLARD F. MEEKER.

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fort reported herein centered on the establishment of an electrode geometry for stable operation, measurements of the temperature and velocity distribution in the tail flame at varying ambient pressures, and qualitative observations of the electrodynamic, magnetic and thermodynamic properties of the tail flame. The axial temperature distribution in the tail flame was measured by spectral line reversal technique for temperatures below 3200°K, and by spectral band analysis above this temperature. Flame velocity was measured by a modification of Rohloff's method, involving a temporary interruption of the arc and observation of the downstream propagation of the resulting disturbance by high-speed cinematography. Surface heat flux rates were measured at 1.0 and 0.1 atmospheres on copper bodies in thermal equilibrium. Finally, diffusivity measurements were made in the tail flame on OFHC copper and graphite plates. AD 142093. Project 7360, Task 73603. Covers work from Apr 1956-Mar 1957. Contract AF 33(616)-3660. AF WADC TR 57-226.

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PB-126761

AFCRC TN 56-57
ASTIA DOCUMENT No: AD-98819

RF Project 664
Technical Report 36

TECHNICAL

REPORT

By

THE OHIO STATE UNIVERSITY
RESEARCH FOUNDATION

Columbus 10, Ohio

To: AIR FORCE CAMBRIDGE RESEARCH CENTER
OPERATIONAL APPLICATIONS LABORATORY
BOLLING AIR FORCE BASE, WASHINGTON 25, D.C.
Contract No. AF 19(604)-1577
Project No. 7681

On: OPERATIONAL TESTS OF MINIATURE MICROPHONES AND RECEIVERS.

Submitted by: Henry M. Moser and John J. Dreher
Department of Speech

Date: October, 1956

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ACKNOWLEDGEMENTS

The authors wish to express their appreciation to Colonel George W. Peterson, wing commander of the 1707th Air Transport Wing, Heavy (Trg.), Palm Beach Air Force Base, for his cooperation in use of base facilities for these evaluations. Thanks are also due for the enthusiasm and help given by the following personnel at Palm Beach Air Force Base in the expediting and conducting of the operational tests reported herein:

Lt. Colonel Roland L. McRae	Director of Operations
Major Paul A. Fredericks, III	Deputy Director of Operations
Major John B. Horsfall	Wing Chief Pilot (Speaker A)
Major Clinton P. Hankins	Chief Pilot (Speaker B) 1742nd Air Transport Sqdn.
Captain Santiago Gonzales	Chief Pilot 1707th Flying Training Sqdn. (A
Captain Muller L. Jones, Jr.	Chief Pilot (Speaker C) 1740th Air Transport Sqdn.
CWO Fred W. Carter	Air Electronics Superintendent

OPERATIONAL TEST OF MINIATURE MICROPHONES AND RECEIVERS

I. INTRODUCTION

While previous laboratory experimentation has shown promising performance with microphones located at positions other than the mouth,[1-4] no operational tests have hitherto been accomplished.

The present interphone system (AIC-10) used in most Air Force craft employs a first-order-differential noise cancelling microphone developed to generate a high quality signal in the ambient noise fields encountered operationally. A modification of this microphone, the M-33, is currently in use in the majority of aircraft flying at moderate altitudes at subsonic speeds. The A13A oxygen mask inserted counterpart, the M-32, in the AIC-10 system is essentially the same microphone but offers the advantage of a shield for the speech signal.

Both these microphones, although functioning satisfactorily in their primary purpose, have presented problems from a standpoint of maintenance. Moreover, the associated headset is considered extremely annoying by personnel on duty in hot, humid climates where long duty periods have resulted in much sweating into the ear cushions. Bases with training missions have been particularly affected by this latter circumstance, in some instances being severely hampered by the spread of ear fungi transmitted through common usage of headsets by students.[5]

The problem, then, from the operational point of view, is two-fold. Both the transmission and reception of signals would be improved by lightening the weight and simplifying radio equipment; hygiene and santitation would be improved by equipment cheap enough to allow personal ownership of components.

Concurrent with laboratory evaluations of ear, bone, and mouth transducer signals,[6] a staff study on an experimental version of a headset-microphone combination adapted to the needs of hot-weather flying was instituted at Palm Beach Air Force Base by Lt. Colonel Roland M. McRae, Director of Operations, 1707th Air Transport Wing, Heavy (Tng), and implemented by Major Paul A. Fredericks, III, Deputy Director of Operations. This study was initiated to attempt a solution to the sanitation and comfort problem discussed above.

The experimental model of this microphone-headset combination is described in a memorandum to Commander, 1707th Air Transport Wing, dated June, 1956. Briefly, this apparatus consisted of a Telex #3776 binaural headset for listening and a modified M-32 microphone. The latter, connected to about three feet of plastic tubing, is clipped to the operator's shirt front. The speech signal is picked up at the speaker's lips by a small plastic circular container of approximately 13 cc capacity attached to a curved 6" section of hollow aluminum tubing borne by the headset. Quite apart from the good quality signal delivered by this apparatus, it offered relief from the weight and discomfort

involved in using the standard H78/AIC headset-microphone (wt. 1 1/3 lbs). Subjective evaluation by Wing personnel had already been favorable and the overall performance amounted, in their judgment, to an improvement over the standard equipment. It was in connection with this staff study that this laboratory was contacted for the purpose of conducting flight tests of some available miniaturized microphones.

Two types of transducers previously used in laboratory studies were considered for testing: a magnetic ear insert, weight 1/2 ounce, a bone oscillator, weight 3/4 ounce. Each could be used for both transmitting and receiving.

Authorization was given for such tests to be made at the 1707th Air Transport Wing, Heavy (Trg.), Continental Division, MATS at Palm Beach Air Force Base, in routine training flights.

II. EXPERIMENTAL DETAILS

A. Aims

The primary aim of the operational test was to compare the efficiencies of the currently used M-33 microphone with selected ear insert and bone transducer as used in conjunction with the AIC-10 communication system. Because of the problems of experimental design posed by an operational test, the second task of comparing receivers could not be rigorously structured. The latter task, however, hardly needed any rigid experimental structure, in view of the attitude of flight personnel to the effect that any relief from the weight, discomfort, and sanitation problems of the standard headset would be a welcom improvement. The results of receiver comparisons will be treated at greater length below.

B. Transmission Tests

1. Stimulus Materials

Stimuli for transmission tests were randomized lists of 200 Harvard PB words. These words, read in trios with time for written responses interspersed, were arranged in lists of 50 words each.

2. Aircraft Selected

Two models of transport aircraft were used in the testing, the KC-97 and the C-124, on the assumption that results achieved with these could be generally applied to all other types of heavy motor craft now in general use. Both airplanes, although not excessively noisy according to present day standards, make some degree of noise exclusion mandatory for satisfactory transmission. Noise levels in the C-124 are somewhat higher than those encountered in the KC-97 (97 db in level flight).

3. Speakers

Comparison readings for the M-33, ear and bone microphones were made by three chief pilots in both the KC-97 and C-124 airplanes. Prior

to reading their test lists all speakers identified themselves and transmitted a standard sample of continuous speech using each type of microphone. This served to prepare the speakers for test list transmissions and for microphone identification. Both pilots who read test material from each aircraft broadcast first with the M-33 microphone, following with ear and bone transducers. In each case the ear microphone was coupled to a custom-fitted ear mold and covered with a David Clark, model 372-8 ear muff. The bone microphone was positioned in the center of the speaker's forehead and held in place by the pressure exerted by the head band, designed for the unit, spanning the head longitudinally. It is to be pointed out that no attempts were made to modify this pressure to obtain optimum performance in view of the limited time available for flight operations. This transducer was not shielded from the ambient noise.

All transmissions were recorded on the ground from the UHF channel assigned, 349.4 megacycles.

4. Equipment

Standard, commercially available equipment was used in all phases of testing. Dyna-Empire magnetic insert earphone model D 314 and Dyna-Empire bone conductor model B 36 were used to transmit signals from the ear and the skull respectively. Preliminary comparison of the output levels of the M-33 microphone and the Dyna-Empire units indicated a level of approximately 20 db less for the latter. Consequently, a transistor preamplifier, was used to increase the signals from the ear and bone transducers. Standard cords were fitted with appropriate connectors for coupling to the AIC-10 transmission system. A model 600 Ampex tape recorder was coupled electrically to the receiver at the ground station by means of a repeat coil to record the test messages.

5. Broadcast Evaluations

a. Listeners

A panel of 10 listeners, trained for a period of 30 hours on the test words, and currently engaged in evaluation of several other experimental microphones, listened to the test lists as read by the participating pilots. Write-down responses were used.

b. Playback of Lists

Two conditions of playback were used, one using only the output of the tape as recorded over the transmission link at the ground station, the other introducing additional noise into the listening circuit. Since the former condition effectively reproduced the listening conditions at the tower station, only these results will be commented on below.

The listeners used PDR-8 headsets fed by the Ampex 600 recorder. Listening was done in quiet. The signal, plus whatever noise was picked up during the recording in the aircraft, was played back through the headsets at a level of 77 db, C scale, on the H.H. Scott 410-B sound level meter. This amount was an average reading taken from three of the earphone

in the listening circuit. In each instance the reading was made by coupling the earphone to the meter by a rubber coupler.

c. Results and Discussion

Two types of materials were transmitted with all three microphones. To identify the microphone, speaker, and test lists subsequently read, the pilots first transmitted a standard passage:

"This is __________, broadcasting with the ________ microphone. Our altitude is 9500 feet. 1,2,3,4,5,6,7,8,9,10. JOE TOOK FATHER'S SHOE BENCH OUT. This is the end of the____________microphone reading."

In addition to this connected speech sample the pilot also gave several brief operational messages (i.e. request for instructions, for quality of signal, etc.) before commencing the second type of material, the PB word lists. During the transmissions and later in playback, communications and operational personnel gave their subjective reactions to the transmissions. The consensus was that all microphones were quite satisfactory (or, as they expressed it, "5 by 5"), a result that requires some comment.

In the first place, any existing differences in the three microphones would tend to be obscured due to the fact that a standard passage was employed and that listeners had knowledge of the content. The operational phrases, however, offered a somewhat more reliable measure, since their content was not exactly foreknown. What may be of much greater importance is the observation that the scale of judgment for connected speech is almost certainly measuring something quite different from that employed in the evaluation of the transmission of the test words. Communications personnel employ, in theory at least, a 5-point yardstick of "readability" and "strength" to evaluate each other's transmissions. An optimum transmission might be labelled "R-5, S-5" ("5 by 5", or "5 square") to denote excellent readibility and strength. Any lower readings given stand for the receiver's judgment of how far the signal departs from optimum reception. In practice, the two 5-point scales are often combined, with no differentiation made between the two categories. "Reading you two," for instance, would thereby indicate poor reception. In view of the fact that operations personnel are generally not interested in the quality of the signal itself but whether or not it can be read, the judgment tends to become even more gross, with a sufficiently strong, readable signal considered "acceptable," and only those circumstances which actually make communication extremely difficult or impossible resulting in a judgment of "unacceptable."

Essentially, then, the signal is labelled either satisfactory or unsatisfactory in operational use, the normal redundance of connected speech tending to iron out differences which might well appear among microphones in the transmission of isolated words. During the recording of the test lists, for instance, experienced operations personnel listening to the transmissions unhesitatingly evaluated samples of connected speech from all three types of microphones as "five by five," a circumstance which seems to indicate that the gradations of difference as established by laboratory tests on trained listening panels may not be significant from an operational point of view. Certainly when such aspects as comfort, ease of handling, and durability of

equipment enter the picture it may become unrealistic to base any performance evaluation solely on the results of articulation scores. They do serve, however to point out the direction for engineering improvement, inasmuch as the transducers compared with the currently used microphone were selected from commercially available sources with no choice of the specific response characteristics necessary for this speaking situation.

An interesting observation may be made regarding the operation of the bone microphone as used in the KC-97 test when the speakers recorded their lists, one wearing ear muffs, one without. At the time of transmission, a noticeable betterment in voice quality was remarked upon by auditors at the ground station when the speaker was wearing muffs, and subsequent listener effort proved that this condition resulted in superior articulation scores. This improvement cannot be attributed to speaker variability since on no other condition was any statistical speaker difference noticed. It is to be supposed that the pressure exerted by the muffs in some way reacted with skull vibration to achieve this more distinguishable signal.

Another point that may be worthy of mention was the expressed opinion of several operational listeners that breath blast from the M-33 microphone makes connected speech "annoying to listen to." Actually, the subjective reactions of most of the operational personnel placed the bone microphone transmissions "better than the present (M-33) mike," an observation running counter to laboratory findings on the comparative readability of the microphones, and one that obviously was based upon additional (and perhaps valuable) criteria not revealed by an articulation test. The extent to which such annoying features of a microphone affect its operational use are largely unassessed, although it is entirely possible that they loom larger in importance to the everyday user than they would to laboratory personnel trained in evaluation of equipment under widely varying conditions of reception.

The statistical evaluation of the tests is presented below. It will be noted from the listener scores on speakers and microphones that speaker variability played some part, as might be expected. Table 1 gives the scores on the PB test words broadcast from the KC-97 and C-124 aircraft.

Table 1. Per cent Correct Scores on Broadcasts from the KC-97 and C-124 Aircraft. (8 Listeners)

KC-97

Microphones

	M-33		Ear		Bone	
Speaker	A	B	A	B	A	B
Quiet	90.0	84.3	83.8	80.5	74.5	82.3
Noise	78.9	68.3	71.7	67.7	59.7	77.4
Mean	84.4	76.3	77.8	74.1	67.1	79.9

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C-124

	Microphones					
	M-33		Ear		Bone	
Speaker	A	C	A	C	A	C
Quiet	89.4	91.7	80.3	[illegible]	75.2	71.7
Noise	80.6	75.1	74.9	57.1	53.1	50.0
Mean	85.0	83.4	77.6	68.3	64.1	60.9

Speaker "A" in the Table above, the Wing Chief pilot, took part in both the broadcasts. Speakers "B" and "C" were also chief pilots, the latter having a decided Southern American dialect. It is of interest to note that this speaker, who participated in the C-124 flight, was made comparatively much less intelligible than his companion with both mouth and ear microphones during playbacks of the stimuli in noise.

Inasmuch as the speakers in the KC-97 recording were operating in an ambient noise field of approximately 97 db and the auditors at the ground station were in comparative quiet, the results of the "QUIET" listening runs were considered as the closer approximation to ground listening conditions and these data were analyzed statistically. An analysis of variance, microphones x listeners, was performed, the results being given in Table 2, below.

Table 2. Analysis of variance: Three Microphones Used in the KC-97 Aircraft.

Source	df	SS	Est. Var.	F	p
Microphones	2	306.5	153.3	14.4	.0
Listeners	7	916.0	130.9	12.3	.0
Remainder	14	148.6	10.6		
Total	23	137.13			

The critical mean difference of 4.80 applied to the KC-97 microphone means (M-33= 87.15, Ear= 82.15, Bone= 78.40, indicates that the M-33 produced scores significantly better at the 1% level of confidence, whereas no difference emerged between the ear and bone transducers.

A similar analysis performed on data from the C-124 transmissions, recorded [illegible] an ambient noise field of approximately 106 db, is given in Table 3.

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Table 3. Analysis of Variance: Three Microphones Used in the C-124 Aircraft.

Source	df	SS	Est. Var.	F	p point
Microphones	2	1066	533.0	14.33	.01
Listeners	6	490	81.7	2.20	
Remainder	12	446	37.2		
Total	20	2002			

A critical mean difference of 8.38 applied to the C-124 microphone means (M-33=90.6, Ear=80.0, Bone=73.3) indicates the M-33 produced scores significantly better than the experimental microphones at the 1% level of confidence, with the ear and bone tranducers again exhibiting no difference.

On a strictly statistical criterion, the M-33 microphone proved best in these tests. It is to be stressed, however, that these results are only a part of the performance evaluation and should be viewed as such. Again the point is made that gradations of difference as established on laboratory tests of isolated words may not override considerations of lightness, ease of use, and sanitation that must be considered in the operational use of equipment. The possibility also exists that the margin of difference as exhibited above might well vanish with the use of connected speech and the highly redundant phraseologies normally employed in traffic operations.

C. Reception Tests

1. The Problem

As mentioned in the introduction to this report, the use of cumbersome, unsanitary headgear is particularly undesirable under conditions of hot-weather flying. This poses problems with exceptionally noisy aircraft such as the SA-16 flying boat. Noise levels upon takeoff, for instance, which run as high as 126 db, make normal interphone communication impossible, even with present equipment, furnishing as it does, some measure of noise exclusion by the circumaural cushion. It is obvious that, although the takeoff condition may last only thirty seconds, this period might well be critical for the safety of the aircraft, and therefore the takeoff reception problem merits special consideration. Much pilot interest had been shown in the possibility of using the insert receiver or bone contact unit to effect a successful substitute for the present headset.

2. Procedure

Because the SA-16 aircraft provided the worst listening conditions encountered at the base,[9] it was selected to try the effectiveness

of the ear and bone units as receivers. The same units could, of course, have been employed as transmitters had it been possible to obtain the SA-16 aircraft fitted with the AIC-10 circuit. Since none of these were available at the time of the test, the trials were limited to listening alone.

The pilot, co-pilot, and one of the experimenters, fitted with custom-built ear molds, were connected to the aircraft's interphone system with three of the miniature insert receivers used previously in the transmission tests as microphones. The T-17 carbon microphone was used in conjunction with the interphone system. Instructions and information were given and received over the system during runup, takeoff, and level flight with good readability. No objective evaluations of the receiver's efficiency were available under these communication circumstances, inasmuch as no recordings were made in the aircraft. In the opinion of the chief pilot in charge of SA-16 operations, however, the communication was excellent and the lightness of the receiver very desirable for such flying duty.

The bone receiver, while functioning better when positioned on the mastoid than at any other location, could not be considered a satisfactory device under conditions in which the ears could not be isolated from the noise. It is possible that the bone transducer would function satisfactorily in conjunction with some types of ear defenders, although this was not tried at the time of testing.

3. Discussion

Interviews with participating pilots and other flying personnel indicated that their requirements for an ideal headset-microphone combination would include satisfactory transmitting and receiving characteristics with no heavy or constricting equipment around the head to impede free sweating. Two-eared listening would be desirable, with at least one-eared listening possible at all times, even when transmitting.

III. CONCLUSIONS AND RECOMMENDATIONS

On the basis of this and other tests it is concluded that differen kinds of flying assignments make any one headset-microphone combination a difficult, if not impossible, ideal. Whereas jet personnel may be satisfied with some sort of earmuff and associated headset due to their habitual use of head protection, equipment satisfactory for their use is entirely unsatisfactory for duty in hot, humid climates at comparatively low altitudes. The operational test of the ear and bone units used as microphones indicated performance equal to that presently used, with considerable relief from a point of view of weight and convenience. The ear insert functioned satisfactorily as a receiver, as well. It should be here pointed out that during these test the ear microphone was furnished with the protection of an ear muff, a featu that would not be acceptable in operational use. Some modifications of the ear microphone have already been effected to increase the signal strength se db, a factor that may make it possible to both send and receive with the same unit without the use of any muff protection.

The use of the bone transducer as a receiver without some isolation of the ears does not seem feasible.

Statistical comparisons of scores of tests on PB words under the conditions of these flights indicated a significant difference in intelligibility in favor of the present M-33 microphone, although the mean difference in test scores was comparatively small.

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3. G.P. Beschle. "An Evaluation of Ear Speech," Master's Thesis. Worcester Polytechnical Institute, 1955.

4. _____________, (Supp. Report No. 2) AFCRC TN 55-64, May 1955.

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6. H.M. Moser, J.J. Dreher, H.J. Oyer, J.J. O'Neill. "Comparison of Mouth, Ear, and Contact Microphones," OSURF Tech. Report 664-37. Oct. 195

7. Noise levels recorded on C-124 at microphone position in aircraft:

Scale (in db)

	A	B	C
Runup	100	88	104
Takeoff			104-106

Meter was H.H. Scott 410-B

8. This transistor amplifier, a Gates Transmote, has a potential of 78 db signal gain, weighs 3 lbs., and operates on 23 1/2 volts furnished by mercury cells. The maximum power was not necessary, only 20 db being utilized.

9. Noise levels measured in the cabin were 126 db on takeoff, 106 db in level flight. Readings were C scale measurements.

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[redacted] Off. Papers

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

PLANTRONICS, INC., Plaintiff	:	CIVIL ACTION
v.	:	No. 72 CIV 1625
ROANWELL CORPORATION, Defendant	:	JUDGE CONNER

DEFENDANT'S SECOND SUPPLEMENTAL ANSWER TO PLAINTIFF'S INTERROGATORIES, THIRD SET

1. State the number of units made by Roanwell, month by month from introduction to date, of the headsets known as: a) Model R61; b) Model R70; c) Model R71.

Answer: Attached is a table (Appendix D) showing the defendant's production of R61 headsets from their introduction in August 1970 to date, for Western Electric.

The information in the attached Appendix D is subject to the Court's secrecy order of May 29, 1974.

ROANWELL CORPORATION

By Lester W. Clark
Lester W. Clark

Ex. 32 149

APPENDIX D

NUMBER OF R-61 HEADSETS MANUFACTURED BY ROANWELL FOR WESTERN ELECTRIC

	1970	1971	1972
January		1,200	2,288
February		1,102	2,114
March		1,719	3,800
April		3,000	2,500
May		1,600	2,500
June		3,100	2,078
July		2,353	526
August	277	2,800	1,442
September	463	3,100	2,404
October	549	3,500	2,399
November	554	3,500	2,500
December	1,000	2,060	1,250
Totals	2,843	29,034	25,801

Grand Total - 57,678

These production figures for Western Electric are considered to be more than 75% of the total Roanwell production figures of R-61 headsets. There has been no production of R-61 headsets for Western Electric since 1972.

STATE OF NEW YORK)
) ss.:
COUNTY OF NEW YORK)

Lester W. Clark, being duly sworn, on oath deposes and says that he is Attorney for Roanwell Corporation, one of the defendants herein, and that he has read the foregoing DEFENDANT'S SECOND SUPPLEMENTAL ANSWER TO PLAINTIFF'S INTERROGATORIES, THIRD SET, and these answers are true and correct to the best of his knowledge and belief.

Lester W Clark

Sworn and subscribed to before me

this 22nd day of August, 1974.

Rita Casey
Notary Public

My commission expires: 3-30-76

RITA CASEY
NOTARY PUBLIC, State of New York
No. 31-5642395
Qualified in New York County
Commission Expires March 30, 1976

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

PLANTRONICS, INC., Plaintiff	Civil Action No.
v.	72 CIV 1625
ROANWELL CORPORATION, Defendant	Judge Conner

STIPULATION

Plaintiff and Defendant hereby stipulate, through their respective counsel, that the data furnished in the attached letter of E. D. Dreyfus, dated July 16, 1974, are substantially accurate and will not be challenged as to accuracy at trial.

Paul M. Janicke
Lester W. Clark
Lester W. Clark

Paul M. Janicke
ARNOLD, WHITE & DURKEE
2100 Transco Tower
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Lester W. Clark
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Robert Neuner
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Ex. 33 152

Western Electric

Edward D. Dreyfus
Patent Attorney

222 Broadway
New York, N. Y. 10038
212 571-4714

July 16, 1974

TOM ARNOLD, Esq.
Arnold, White & Durkee
2100 Transco Tower
Houston, Texas 77027

Dear Mr. Arnold:

Re: Pacific Plantronics, Inc. v. Roanwell Corporation
Civil Action 72 CIV 1625 U.S. Dist. Ct. S.D. of N.Y.

Pursuant to Plantronics' request on Western Electric for the production of information and the Stipulation and Order signed by Judge Conner, May 29, 1974 in the above identified action (copy attached) the following information is submitted.

1. The first commercial delivery by Western Electric of the Model 52 head set occurred some time in 1945. Our records do not reveal the exact date within 1945 upon which such delivery occurred.

2. The number of Models 61A and 61B head sets manufactured and shipped by Western Electric from the date of introduction to present are set forth on Attachment A to this letter. We wish to advise that the stated quantities represent those Western Electric manufactured head sets shipped during the month indicated from Western Electric's manufacturing location.

In a vast majority of cases, the head sets were shipped to Western Electric Service Centers throughout the country and subsequently shipped to Western Electric customers. An insignificant number (estimated at less than 20 may have been shipped from the Western Electric manufacturing location to BTL.

Very truly yours,

:at

E. D. DREYFUS

cc:
Cooper, Dunham, Clark, Griffin & Moran
L. C. Kraus - WECO

ATTACHMENT "A"

Model 61A

	1970	1971	1972	1973	1974
January		160	659	0	0
February		164	118	0	0
March		728	54	0	0
April		1832	0	0	0
May		752	0	0	0
June		1760	0	0	0
July		344	0	0	-
August		1344	0	0	-
September		1104	0	0	-
October	0	2088	1	0	-
November	104	1176	0	0	-
December	96	240	0	0	-
Total	200	11692	832	0	0

Model 61B

	1971	1972	1973	1974
January	0	0	0	0
February	0	0	0	0
March	0	880	0	0
April	0	798	0	0
May	0	403	0	0
June	0	1212	0	0
July	0	803	207	-
August	0	200	519	-
September	40	532	0	-
October	376	48	0	-
November	232	0	0	-
December	9	0	0	-
Total	657	4876	726	0

This information is property of Western Electric and is subject to the Court Order signed by Judge Conner, May 29, 1974 in Pacific Plantronics, Inc. v. Roanwell Corporation 72 CIV 1625, U.S. District Court, S.D. of N.Y.

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

U. S. DISTRICT COURT FILED MAY 30 1974 S. D. OF N. Y.

PACIFIC PLANTRONICS, INC., Plaintiff,	:	Civil Action
v.	:	72 CIV 1625
ROANWELL CORPORATION, Defendant.	:	Judge ~~Knapp~~ Conner

STIPULATION AND ORDER

IT IS HEREBY STIPULATED AND AGREED by and between Pacific Plantronics, Inc. (Plantronics), Roanwell Corporation (Roanwell) and Western Electric Company, Incorporated ("Western Electric") by their respective attorneys that:

1. Plantronics has requested Western production of the following information:

(1) The date of first commercial delivery by Western Electric of the Model 52 Headset.

(2) The number of Model 61 Headsets manufactured and shipped by Western Electric to its customers each month from date of introduction to present.

Roanwell fully consents to Western Electric producing this information (hereafter "information") to Plantronics and Roanwell.

The information shall be made known to Arnold, White & Durkee, counsel for Plantronics and Cooper, Dunham, Clark, Griffin & Moran, counsel for Roanwell.

2. It is understood and agreed that Western Electric asserts the subject information is proprietary business information of Western Electric, and the parties hereto agree that any further disclosure of the information (or portions thereof) shall be governed by the provisions of this Stipulation and Order.

3. Except as required in the conduct of Court proceedings or depositions, Western Electric information or portion thereof shall not be disclosed or used by any person other than Plantronics counsel and Roanwell counsel ("counsel" includes house counsel directly involved in this litigation and outside counsel retained in connection with this litigation), technical experts and consultants to such counsel (whether or not in the employ of either party to this action) and necessary secretarial and clerical personnel, except as otherwise provided in this Stipulation and Order. Before any document or information is disclosed to any person not within the above categories that person shall be given a copy of this Stipulation and Order and shall acknowledge in writing to Plantronics or Roanwell or their counsel that he is fully familiar with the provisions of the Order and agrees to comply with and be bound thereby.

4. The subject information shall be used by Plantronics and Roanwell counsel, technical experts and consultants to such counsel and necessary secretarial and clerical personnel only for the purposes of this action and shall not be otherwise published, disclosed, or used.

5. If Plantronics or Roanwell shall plan to file or present in Court or make public in connection with a proceeding

in Court, or to use at a deposition, any Western Electric information supplied to it pursuant to this Stipulation and Order, Plantronics and Roanwell shall give reasonable notice to Western Electric in order to provide Western Electric an opportunity to seek a protective order from the Court before such information is filed or presented, but Plantronics and Roanwell reserve the right to oppose any such application. Plantronics and Roanwell will not file or present in Court or make public in connection with any proceeding in Court, any such Western Electric information until a ruling has been made on any motion for a protective order filed by Western Electric. Alternatively, Plantronics and Roanwell may file Western Electric information in Court under seal, with instructions to the Clerk of the Court, that pursuant to this Stipulation and Order, the information filed under seal are not to be disclosed to any person other than the Court or counsel for the parties to this action unless otherwise ordered by the Court.

6. The restrictions and obligations relating to Western Electric information set forth in this Stipulation and Order shall not apply to any such information which Plantronics, Roanwell and Western Electric agree, or the Court rules, is already public knowledge or becomes public knowledge other than as a result of disclosure by Plantronics or Roanwell, or which has come or shall come into Plantronics' or Roanwell's possession independently of Western Electric and shall not be deemed to prohibit Plantronics or Roanwell counsel from discussing with any person any such information if that person already has possession on a non-confidential basis of all of the information to be discussed from an independent source unrelated to Plantroni Roanwell or Western Electric, and not resulting from disclosure

from any of them.

7. Neither this Stipulation and Order nor the provision by Western Electric of information pursuant to this Stipulation and Order, shall be deemed to have the effect of any admission or waiver by Plantronics, Roanwell or Western Electric or of altering the confidentiality or non-confidentiality of any such information or of altering any existing obligation of Plantronics, Roanwell or Western Electric, or the absence thereof.

ARNOLD, WHITE & DURKEE

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212/571-6327

Dated: MAY 24, 1974

SO ORDERED:

William C. Conner
Judge, U.S.D.C.
S.D.N.Y.

CIV ACTION NO. 72 CIV [illegible]
JUDGE COL[illegible]

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

[illegible]TRONICS, INC.,

Plaintiff,

v.

ROAMWELL CORPORATION,

Defendant.

STIPULATION AND ORDER

BRUMBAUGH, GRAVES, DONOHUE & RAYMOND
30 ROCKEFELLER PLAZA
NEW YORK, N. Y. [illegible]
212 – [illegible]

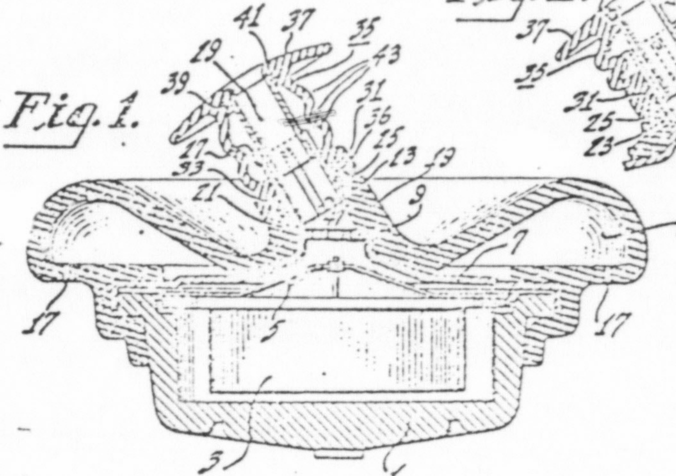
Nov. 14, 1950 D. W. MARTIN 2,529,562

ADJUSTABLE EARPIECE FOR RECEIVERS

Filed Jan. 2, 1947

Fig. 2.

Fig. 1.



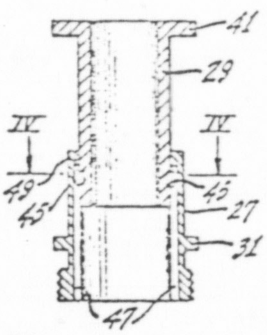


Fig. 3.

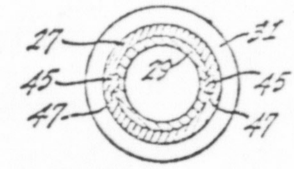


Fig. 4.

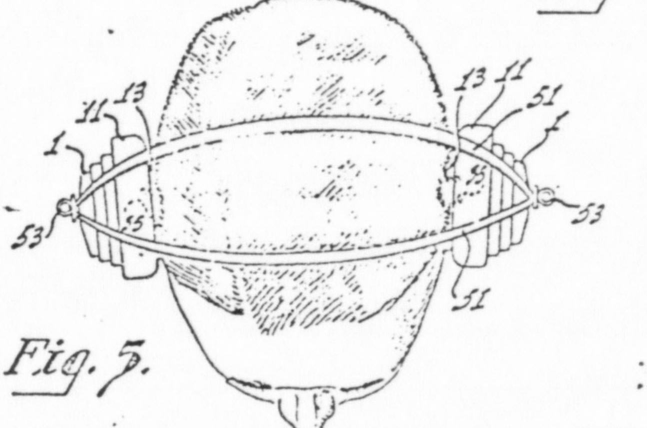


Fig. 5.

INVENTOR
DANIEL W. MARTIN
BY
C D Tuska
ATTORNEY

Ex. 34 161

Patented Nov. 14, 1950

2,529,562

UNITED STATES PATENT OFFICE

2,529,562

ADJUSTABLE EARPIECE FOR RECEIVERS

Daniel W. Martin, Blackwood, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application January 2, 1947, Serial No. 719,651

13 Claims. (Cl. 179—182)

1

This invention relates to telephone receivers of the type that are worn on the head ~~and~~ are commonly referred to as headset receivers, and more particularly to an earcap for use on such receivers.

Headset telephone receivers are frequently used in locations where surrounding noise is at a high level, as in battleships, airplanes, and the like. When the external noises are loud, the signal to noise ratio is correspondingly low and it becomes difficult to hear the signals clearly. To avoid this condition, various types of earcaps have been proposed heretofore for use on receiver units for the purpose of sealing the ears of the user against external noise. However, such earcaps have not proven satisfactory for one reason or another.

The primary object of my present invention is to provide, in a headset telephone unit, an improved earcap which will effectively seal off external noises when applied to the ear so that the signal to noise ratio will be maintained quite high.

More particularly, it is an object of my present invention to provide an improved earcap for headset receivers by means of which a great reduction in external noise will be obtained and thereby the sensitivity and low frequency response of the receivers will be greatly improved.

Another object of my present invention is to provide an improved earcap for headset receivers which will effectively acoustically seal against external noises not only the outer ear but also the auditory canal of the ear at the point of maximum flare in the auditory canal cross section.

Still another object of my present invention is to provide an improved earcap as aforesaid which may be made in one size and shape and yet will accurately fit ears of various sizes.

A further object of my present invention is to provide an improved earcap as aforesaid which can be worn with great comfort by the user.

Still a further object of my present invention is to provide an improved earcap as above set forth which can be applied to the ear quickly and accurately and which is not apt to become dislodged easily to a position where it will be ineffective to seal the ear against external noises.

It is also an object of my present invention to provide an improved earcap for headset receivers which is simple in construction, inexpensive in cost, and highly efficient in use.

In accordance with one form of my present invention, the earcap comprises a pad of soft

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rubber, such as sponge rubber, constructed to be mounted on the casing of a headset receiver and adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor. The pad has a central opening and it is provided over said opening with a tubular member which extends therefrom and which preferably terminates in a flange adapted to seat against the auditory canal of the ear at the entrance thereof (that is, where the auditory canal is of maximum flare in cross section) to thereby provide an internal acoustical seal for the ear. The tubular member is preferably made of fairly thin, soft rubber and is disposed with its axis angularly related to the axis of the aforementioned pad, the angle being such that, when the pad is applied to the ear, th tubular member will extend to the auditory canal at the proper angle.

The aforementioned tubular member is formed with one or more circumferential accordion pleats whereby it is collapsible and expansible along its own axis for accomodation to ears of different sizes. Since the tubular member is made of thin rubber and is, therefore, flexible, it is capable of flexing or bending in all planes passing through its axis. To prevent this tubular member from so bending when it is applied to the ear, I provide within it a pair of rigid, telescopically arranged tubes one of which slides within the other as the tubular member expands or contracts. The telescopic arrangement of the tubes permits free collapse and expansion of the tubular sealing member while at the same time preventing bending of this member. In this way, the angular relation between the axis of the tubular extension on the ear pad and the axis of the ear pad itself or the vibratory diaphragm forming part of the transducer unit in conventional telephone receivers is maintained constant. At the same time, however, the tubular sealing member is free to be adjusted and to accommodate itself to ears of different sizes whereby a good seal can be obtained for the ear.

The novel features that I consider characteristic of my invention, both as to its organization and method of operation, as well as additional objects and advantages thereof, will better be understood from the following description of one embodiment thereof when read in connection with the accompanying drawing in which

Figure 1 is a central sectional view of a telephone receiver with an earcap according to my present invention applied thereto and with the tubular member which acts as a seal against

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the auditory canal shown in fully expanded position,

Figure 2 is a fragmentary sectional view of my improved earcap showing the aforesaid tubular member in contracted or collapsed condition such as it would occupy when applied to the ear,

Figure 3 is an enlarged, central, longitudinal, sectional view of the telescopically arranged tubes within the aforesaid tubular sealing member and which maintain this member against flexure or bending in planes containing the axis thereof,

Figure 4 is a sectional view taken on the plane of the line IV—IV of Figure 3, and

Figure 5 is a top plan view showing a headset comprising a pair of receiver units provided with my improved earcap applied to the head of the user.

Referring more particularly to the drawing wherein similar reference characters designate corresponding parts throughout, there is shown, in Figure 1, a telephone receiver having a casing 1 within which is housed an electro-acoustical transducer 3 of any suitable type. The transducer 3 may be a sound powered telephone unit, for example, operating in well known manner and having a diaphragm 5 which generates acoustical waves during vibration thereof. A guard plate 7 having a perforated, central extension 9 serves to protect the diaphragm 5, the perforations in the extension 9 serving to permit passage of sound waves generated by the diaphragm 5.

Fitted around the marginal portions of the casing 1 and the guard plate 7 is an ear pad 11 which may be molded out of sponge rubber or other suitable, soft material. The pad 11 is adapted to be placed against the outer ear 13 of a user, as shown in Figure 5, to provide an external acoustical seal against sounds in the ambient. If desired, the pad 11 may be made hollow to provide a chamber 15 which communicates with the outside air through a plurality of openings 17. This provides an air cushion for the pad 11 and helps to insure a snug fit of the pad against the ear whereby both comfort to the wearer and a good seal against external sounds are assured.

The pad 11 is provided with a tubular extension 19 which fits around the guard plate extension 9 and extends in a direction such that its axis is angularly related to the common axis of the pad itself and of the diaphragm 5 for a purpose to be presently set forth. The extension 19 is formed with an annular slot 21 in which is seated the flange 23 of an internally threaded, metallic insert 25. The outer one of a pair of telescopically arranged, rigid, metallic tubes 27 and 29 is threaded into the insert 25 and is provided with a flange 31 which seats in an annular slot 33 of a tubular member 35 made of fairly soft rubber and therefore quite flexible. The tubular member 35 is held in place against the ear pad extension 19 in extension thereof by having its base flange 36 clamped firmly between the insert 25 and the flange 31 of the tube 27. The member 35 terminates in a flange 37 adjacent to which it is formed with an annular slot 39 in which is seated a flange 41 on the inner tube 29.

It will be noted that the flexible, tubular member 35, the two rigid, telescopically arranged tubes 27 and 29, and the ear pad extension 19 are all arranged on a common axis which is angularly related to the common axis of the ear pad proper and the diaphragm 5. This angular relation is such that, when the receiver is applied to the ear, the tubular member 35 will extend in the direction of (that is, substantially coaxially with) the auditory canal of the ear, and the flange 37 will fit snugly against this canal at the point of maximum flare thereof in cross section (that is, at the entrance thereto) to thereby provide an internal acoustical seal for the ear. The combined action of the pad 11 and the flange 31 effectively seals the ear against troublesome outside noises which may be encountered and therefore not only enhances the low frequency response of the receiver but also improves the sensitivity thereof.

Since the ears of different individuals vary in size, some provision must be made to insure a snug fit of the flange 37 against the auditory canal entrance. For this purpose, the tubular member 35 is formed with one or more circumferential, accordion pleats 43 by reason of which it is axially compliant and therefore collapsible in an axial direction from its normally fully extended position of Fig. 1 to its contracted position of Fig. 2, and vice versa. A pair of diametrically opposed lugs 45 on the tube 29 which ride in longitudinal slots 47 in the tube 27 limit the outward movement of the tube 29 relative to the tube 27 by engagement with the upper end 49 of the tube 29 to thereby limit the amount or extent of expansion of the tubular member 35. Engagement of the portion of the member 35 under the flange 41 with the end 49 of the outer tube 27 may be availed of to limit the amount of collapse of the tubular member 35, if necessary. The collapse and expansion of the member 35 is permitted by reason of the telescopic action of the tubes 27 and 29. At the same time, since the tubes 27 and 29 are rigid, they maintain the flexible, tubular member 35 against flexure or bending in planes containing its axis. In this way, the angular relation between the axis of the tubular member 35 and the axis of the ear pad 11 and the diaphragm 5 is maintained constant and a proper fit of the flange 37 against the auditory canal entrance is further assured.

A pair of receivers with earcaps such as described above may be mounted on a headband consisting of two, close-fitting metallic bands 51 which are adapted to fit over the head, as shown in Fig. 5. Preferably, the headbands 51 are arranged so that they join at the sides just in front of the ears, where metal strips or links 53 connect the bands 51 with the receivers. As the receivers are placed on the ears, the headband construction causes the receivers to turn easily in such a direction as to help the flanges 37 of the earcaps to seat properly against the auditory canal entrances while at the same time causing the ear pads 11 to fit snugly against the ears.

Although I have shown and described only a single embodiment of my present invention, it will undoubtedly be apparent to those skilled in the art that many other forms thereof, as well as variations in the particular one described, are possible. I therefore desire that the particular form of my invention described herein shall be considered as illustrative and not as limiting.

I claim as my invention:

1. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad and terminating in

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a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said pleated tubular member including means whereby it is longitudinally compliant for adjustment in an axial direction for accommodation to ears of different sizes.

2. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said pleated tubular member also being disposed with its axis angularly related to the axis of said pad and including means whereby it is longitudinally compliant for adjustment along its own axis for accommodation to ears of different sizes.

3. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a pleated tubular member extending from said pad in a direction such that its axis is angularly related to that of said pad, said pleated tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver and terminating in a flange adapted to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear and including means whereby it is longitudinally compliant for adjustment along its own axis for accommodation to ears of different sizes.

4. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member also being disposed with its axis angularly related to the axis of said pad and having means including at least one accordion pleat circumferentially thereof whereby said tubular member is collapsible and expansible along its own axis for accommodation to ears of different sizes.

5. An earcap according to claim 4 characterized by the addition of means in association with said tubular member for limiting the amount of collapse and expansion thereof.

6. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, and characterized further by the addition of means in association with said tubular member for maintaining said member against flexure in said planes.

7. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, and characterized further by the addition of a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes, said tubes being telescopic to permit collapse and expansion of said member along its axis.

8. An earcap according to claim 4 characterized in that said tubular member is itself flexible in planes containing its axis, characterized further by the addition of a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes, said tubes being telescopic to permit collapse and expansion of said member along its axis and including means for limiting the telescopic action thereof whereby to limit the amount of collapse and expansion of said tubular member.

9. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said paid having a chamber therein adapted to receive a telephone receiver, a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member being compliant whereby it is normally free to flex in planes containing its longitudinal axis and being formed with accordion pleats circumferentially thereof whereby it is collapsible and expansible along its axis for accommodation to ears of different sizes, and a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes while permitting collapse and expansion of said member by reason of their telescopic arrangement.

10. An earcap for headset telephone receivers which comprises a pad adapted to be placed against the outer portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, a tubular member extending from said pad and communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said tubular member terminating in a flange adapted to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member also being made of flexible material whereby it is normally free to flex in planes containing its longitudinal axis and being formed with accordion pleats circumferentially thereof whereby it is collapsible and expansible along its axis for accommodation to ears of different sizes, and a plurality of telescopically arranged, rigid tubes within said tubular member for maintaining said member against flexure in said planes while permitting collapse and expansion of said member by reason of their telescopic arrangement.

11. In a headset telephone receiver having a casing, and an electro-acoustical transducer within said casing including a vibratory diaphragm, an earcap for the telephone receiver

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adapted to be mounted on the casing over the diaphragm, said earcap compri[illegible] (1) a pad adapted to be placed against the [illegible] portion of the ear to provide an external acoustical seal therefor, said pad having a chamber therein adapted to receive a telephone receiver, and (2) a tubular member extending from said pad and terminating in a freely disposed end, said tubular member communicating with said chamber to provide a passage for sound waves emanating from the telephone receiver, said freely disposed end being of a size to seat against the auditory canal of the ear at the entrance thereof to provide an internal acoustical seal for the ear, said tubular member having communication with said chamber for transmission to the auditory canal of the acoustical waves produced by said diaphragm during vibration thereof and having means including at least one accordion pleat circumferentially thereof whereby said tubular member is collapsible and expansible for accommodation to ears of different sizes without affecting its communication with said diaphragm.

12. The invention set forth in claim 11 characterized in that the axis of said tubular member is angularly related to the axis of said diaphragm.

13. The invention set forth in claim 11 characterized in that the axis of said tubular member is angularly related to the axis of said diaphragm, and characterized further by the addition of means in association with said tubular member for maintaining said angular relation constant.

DANIEL W. MARTIN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

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2,447,470	Valentine	Aug. 17, 1948

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Feb. 19, 1952 R. C. GILBERT 2,586,644

HEADSET

Filed Feb. 10, 1949 2 SHEETS—SHEET 1

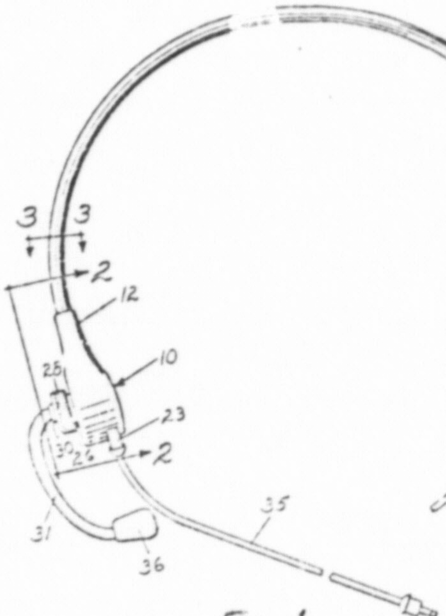
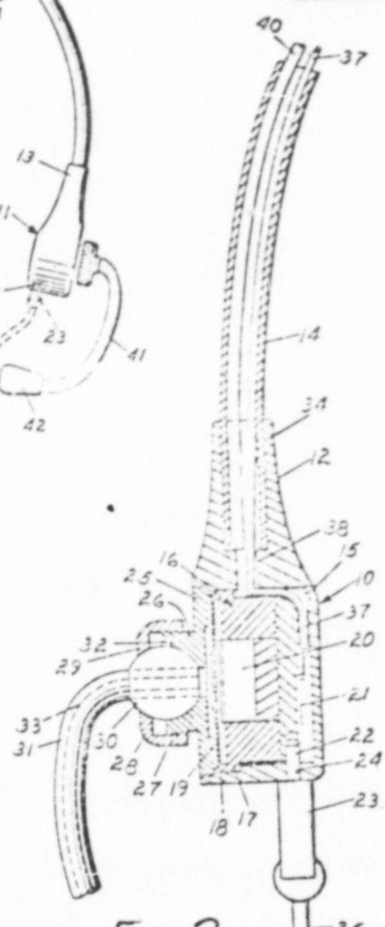


FIG. 1



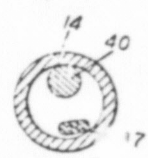


FIG. 3

FIG. 2

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Ex. 35 166

Feb. 19, 1952 R. C. GILBERT 2,586,644

HEADSET

Filed Feb. 10, 1949 2 SHEETS—SHEET 2

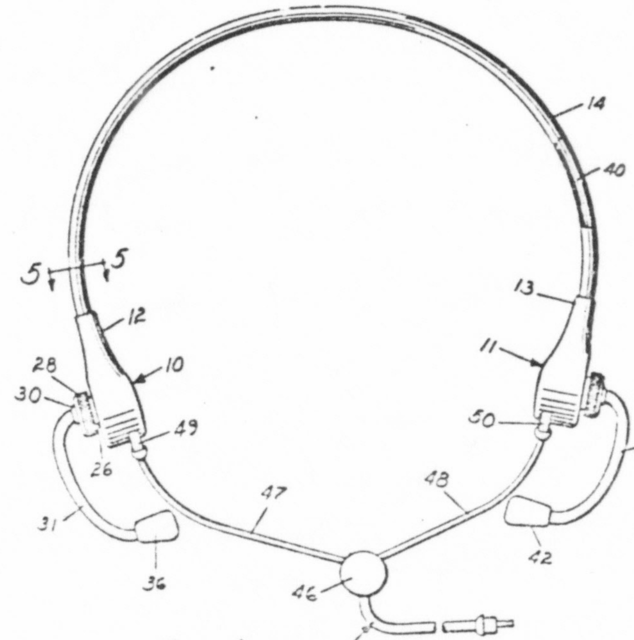

FIG. 4

FIG. 5

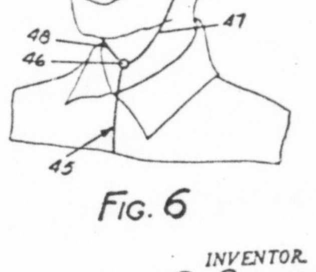

FIG. 6

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Patented Feb. 19, 1952 2,586,644

UNITED STATES PATENT OFFICE

2,586,644

HEADSET

Russell C. Gilbert, Stillwater, Minn., assignor to Telex Inc., Minneapolis, Minn., a corporation of Minnesota

Application February 10, 1949, Serial No. 75,709

9 Claims. (Cl. 179—156)

1

This invention relates to head sets and more particularly to light-weight head sets of the type which are worn by telephone operators, dictaphone transcriptionists and others over long periods of time. Head sets have previously been provided wherein the sound reproducer units are mounted so as to provide direct communication from the sound reproducer unit to the ear. In such head sets the sound reproducer units have been mounted so as to fit over the ear of the user when the head set is used. In other head sets there have been provided a sound reproducer unit suspended below the chin of the wearer and provided with a harp or wishbone-shaped ear tubes leading to ear tips that are placed in the ears of the operator. All of the foregoing types of head sets are subject to the [illegible] that a certain amount of pressure is applied to the ear of the wearer, which is a sensitive portion of the body and is subject to the disadvantage that such pressure, however slight, when long continued may cause some discomfort of the wearer.

It is an object of the present invention to provide an over-the-head head set which can be worn by the operator for extended periods of time without pressure on the ears of the wearer.

It is more particularly an object of the invention to provide an over-the-head head set wherein the sound reproducing units are worn adjacent the ear and the sound communicated therefrom to ear tips which may be adjusted to any position in proximity with the ear, and either in or out of contact therewith.

It is a further object of the invention to provide an improved, light-weight, over-the-head head set having dual sound reproducer units and also to provide an over-the-head head set having sound reproducer units which, when worn by the operator, are located adjacent the ear and sound conduits provided therefrom equipped for adjustment so as to bring the conduit into close proximity or contact with the ear canal as desired.

Other and further objects of the invention include the provision of an improved light-weight head set having adjustable ear tips on the sound reproducer units and to provide an improved head set having a single or double cord arrangement to dual sound reproducer units of the head set.

Other and further objects of the invention are those inherent in the apparatus herein illustrated, described and claimed.

The invention is illustrated with reference to the drawings in which corresponding numerals refer to the same parts and in which:

Figure 1 is a front elevational view of one form of the invention;

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Figure 2 is an enlarged fragmentary longitudinal sectional view taken along the center line of one of the sound reproducer units of the head set shown in Figure 1 and in the direction of arrows 2—2 of Figure 1;

Figure 3 is an enlarged sectional view taken along the line and in the direction of arrows 3—3 of Figure 1;

Figure 4 is a front elevational view of a slightly modified form of the invention;

Figure 5 is an enlarged sectional view taken along the line and in the direction of arrows 5—5 of Figure 4;

Figure 6 is a quarter front view of an individual wearing the head set of Figure 4.

Referring to Figures 1, 2 and 3 there is illustrated a head set having duplicate sound reproducer casings generally designated 10 and 11, each of which terminates in a side arm 12 and 13 into which a tubular head bow 14 of plastic material or the like is inserted. The construction of the sound reproducer casings 10 or 11 is illustrated by the sectional view shown in Figure 2 wherein it will be noted that the casing is provided with a recess 15 into which the sound reproducer unit generally designated 16 is adapted to repose. The second reproducer unit 16 is of minute size of the type customarily used for hearing aid sets for the hard of hearing. The sound reproducer unit includes an exterior frame 17 terminating at a flange 18 in which the diaphragm 19 of the sound reproducer unit is placed, the diaphragm being held in place by the magnetism of pole pieces 20. Coils surrounding the pole pieces, not illustrated, are connected to a pair of terminals, one of which is shown at 21 in Figure 2. The terminals are in the form of clips to receive parallel terminals 22 of a removable plug 23 which when inserted through holes 24 in the bottom portion of the casing permit connection to the terminals and hence to the sound reproducer unit. The casing 10 is provided with a screw plate 25 threaded or pressed into the casing 10 having an upstanding hub portion 26 that is threaded at 27 to receive the cap 28. The cap has a circular opening in its center and is provided with a spherical recess 29 which serves to hold the ball end 30 of short inflexible ear tube 31 which extends out of the hub 11 and terminates at an ear tip 36, see Figure 1. The hub portion 26 has a spherical recess 32 corresponding to the shape of the ball 30 into which the ball portion 30 is placed before the cap 28 is tightened down. The ball 30 is bored so as to receive the ear tube 31 and the ear tube and ball portion provide a tubular conduit 33 through which the

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sound emanating from the diaphragm 19 is adapted to pass and be delivered to the ear tip 36.

The side arm portion 12 of the sound reproducer casing is bored out at 34 so as to receive the tubular head bow 14 which is preferably of plastic material, although light-weight metal may also be used. In the preferred embodiment of the invention the entire casing 10 is of molded plastic.

In the form of invention shown in Figure 1 a single cord 35 is provided having a pair of conductors which terminate at a plug 23 having a pair of terminal points of which one, viz. terminal 22, is shown in the sectional view, Figure 2, the other terminal point lying immediately behind the terminal 22. These pin terminals are engaged by a pair of spring terminals on the back of the sound reproducer unit 16, of which one such terminal 21 is shown, the other lying immediately behind, and as previously stated these terminals are connected to the coils of the sound reproducer unit.

Also connected to the terminals are a pair of wires in cord 37 which extends around the rear portion and up one side of the sound reproducer unit and thence through the aperture 38 and into the inside of the tubular head bow 14, whence it extends around to the opposite sound reproducer casing 11, which, as previously stated, is identical with that shown at 10 and in Figure 2 just described. In that sound reproducer casing 11 the cord pair 37 is connected to corresponding terminals on the back of the sound reproducer contained within casing 11. It will be noted that the casing 11 has a pair of apertures at 33 to which the pin terminals of plug 23 may be inserted when it is desired to plug in the cord to the sound reproducer casing 11 instead of to the sound reproducer casing 10, as shown. In this way the operator has freedom of choice in that she may plug the cord 35 into either of the sound reproducer casings, depending upon which side she desired to have the cord hung when the set is worn. Within the tubular head bow 14 there is also placed a springy stiffening wire 40 which provides slight pressure and still, when bent, can be adjusted as to to fit the heads of individual operators.

When the sound reproducer shown in Figures 1–3 is worn on the operator, the sound reproducer casings 10 and 11 are positioned at approximately the temples of the wearer and the ear tubes 31 and 41 extending from the sound reproducer casings 10 and 11, respectively, and terminating in ear tips 35 and 42, are then adjusted by the operator so that the ear tips reach into proximity to the ear canal. It is unnecessary, for satisfactory operation, to have the ear tube actually in contact with the wearer, although some may desire to adjust the ear tubes to such position. Consequently, the wearer may, if desired, adjust the ear tubes so as to receive the sounds delivered by the ear tips 36—42 without enduring any pressure whatever on the ear canel or any portion of the ear, the slight tension of the bow 14 which provides the pressure of sound reproducer casings 10—11 on the wearer being taken instead by the sturdier portions of the head of the wearer, viz. the temples portion. Also, if desired, the wearer may shift the head set from one position to another so as to shift the pressure of the sound reproducer casings 10—11 from one spot to another on the temple or over-ear or behind-ear portions of the head and in any position the short adjustable ear tubes 31—41 can be repositioned so as to bring the ear tips 36—42 into proximity with the ear canal. This is a distinct advantage when the device is worn for long periods of time.

Referring to the device shown in Figure 4, it is exactly the same as that shown in Figures 1–3 with the exception that the interconnecting pair of wires 37 between the sound reproducer head set is omitted in the over-the-head bow 14. Accordingly, the sound reproducer units within the casing 10 and 11 are not interconnected electrically and for the purpose of communicating the electrical sound-signals to the sound reproducer unit there is provided a branched cord shown generally at 45 terminating in a connection block 46 from which a pair of cords 47—48, which are connected parallel to the wires of cord 45, emanate. The cords 47—48 are each provided with plugs connectors at 49—50, respectively, which are plugged or jacked into the openings provided in the base of the sound reproducer casings 10—11, thus making electrical connections to the sound reproducers therein. As shown in the sectional view in Figure 5 the over-the-head bow 14 includes a stiffening wire 40 as previously described, but there is no electrical connection in the tube 14. Figure 6 is self-explanatory and illustrates one position in which the head set shown in Figure 4 may be worn by the operator. It is to be understood that the twin cord generally designated 45—46—47—48 shown in Figure 6 may be substituted by the unit shown at 35 in the event the head bow 14 has electrical connection between the sound reproducers of the head set, as explained with reference to Figures 1–3.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What I claim is:

1. An over-the-head head set comprising a pair of small sound reproducer units each including an electrical sound reproducer element, said units being mounted at opposite ends of a flexible over-the-head head bow, said sound reproducer units having substantially smooth faces opposing each other and each of said sound reproducer units being provided with a short ear tube movably connected in operative sound-communicating relation thereto, at a point other than said smooth face of the unit for adjustably positioning the ear tube with reference to the unit when the head set is worn, electrical connections between the sound reproducer elements and an exterior cord connected to said elements.

2. An over-the-head head set as set forth in claim 1 further characterized in that the ear tubes are connected to the sound reproducer units by a ball and socket connection having an adjustable frictional engagement for holding the ball connection in any position to which it is adjusted.

3. An over-the-head head set as set forth in claim 1 further characterized in that electrical connection is made between the electrical sound reproducer elements by means of a pair of electric wires contained within the over-the-head bow and plug connections are provided at each sound reproducer unit for receiving a cooperating electrical connection of an exterior cord.

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4. A sound reproducer unit of the type set forth in claim 1 further characterized in that parallel electrical connections are made to each sound reproducer element from an exterior supply pair.

5. An over-the-head head set comprising a tubular head bow, a casing connected at each end of the head bow, said casing having a substantially smooth face facing the other casing, a sound reproducer in each casing, each sound reproducer having a diaphragm, each of said casings having a tubular protuberance adjacent the diaphragm providing a conduit through which sounds emanating from said diaphragm may be communicated, said tubular protuberance extending from said casing on a face other than said smooth face and a short adjustable ear tip connected to said protuberance for adjustment to varying angular dispositions relative to the conduit therein, each said ear tube terminating in an ear tip, and electrical connections from the sound reproducer in one casing and through the tubular head bow to the sound reproducer unit of the other casing.

6. The head set described in claim 5 further characterized in that each casing is provided with a pair of spring terminal connections and apertures adjacent thereto for receiving pin connections of an exterior plug cord for supplying the sound reproducers of the head set.

7. An over-the-head head set comprising a tubular plastic head bow, a molded plastic casing at each end of the head bow, each such casing having a relatively smooth face facing the other casing and being provided with a recess for receiving a sound reproducer unit of the hearing aid type therein, each casing having a channel therein communicating with the channel of the tubular head bow, a sound reproducer unit positioned in the recess of each casing, a metallic cap removably attached to the casing, said metallic cap and sound reproducer unit of each casing being formed so that when the cap is attached pressure is placed upon the sound reproducer unit for holding the same firmly within the casing, each said cap having a central tubular boss, having a spherical central recess therein, an apertured cap screw threaded upon said boss and an ear tube, each ear tube terminating in a ball received in said spherical recess and an ear tip on each ear tube.

8. The over-the-head head set of claim 7 further characterized in that electrical connection is provided through the tubular head bow from the sound reproducer unit situated in one plastic casing and connected to the sound reproducer unit situated in the other plastic casing.

9. An over-the-head head set comprising a tubular head bow, a casing connected at each end of the head bow, each of said casings having a substantially smooth face facing inwardly of the bow, a recess extending into each of said casings from a face opposite to the smooth face, a sound reproducer unit of the hearing aid type in each of said recesses, an ear tube adjustably connected to each of said sound reproducer units and extending outwardly therefrom and adapted for variably positioning the ear tube with reference to the unit when the head set is worn, electrical connections between the sound reproducer units and an exterior cord connected to said units.

RUSSELL C. GILBERT.

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2,390,794	Knight	Dec. 11, 1945

170

sweaty cans. Mike is mounted in shock absorbing tenite at end of fully adjustabl[e] boom—angled for best pickup. Choice of general purpose 50 ohm carbon mike (output 30 db above 1MV) or 256-ohm noise cancelling differential magnetic [mi]ke (output—85 db below 1 Volt/Microbar).

BE SURE TO ORDER BY CATALOG NUMBER

Stock Number		Catalog Number Carbon Mike	Catalog Number Noise Cancelling Mike
18260	Headset w/double receivers & 5' cord w/terminal clips less plug	BCW-12	BMW-
18250	Headset w/single receivers & cord as above	BCW-11	BMW-
18240	Headset w/no receivers, mike only & cord as above	BCO-1	BMO-1
18230	TV type headset w/double receivers, split phone & cord as above	BCW-13	BMW-13
18200	Headset w/double receivers, no cord	BCW-02	Not Available
18220	Headset w/single receiver, no cord	BCW-01	"
18235	Headset—split phone, no cord	BCW-03	"
Lugs	Cord unit w/term. packed separately, no plug	CME-1	"
9261	Aircraft-type cord w/PL-55 and PL-68 or equiv.	CME-5	"
12061	Aircraft-type cord w/push-to-talk switch	CME-3	"
9262	Standard cord w/PL-68 or equiv.	CME-2	"
Lugs	Switchboard-type cord w/standard plug	CME-4	"
Lugs	"Y" cord, 6 conductor, for headset #13235 w/term. packed separately, no plug	CME-95	
3280-22	*Cord unit for receivers for noise cancelling mike equipped headsets (order plug separately)	CMM-1	

PLAINTIFF'S EXHIBIT

MONOSET® Here's the ORIGINAL under-chin, lightweight headset. Ideal for listening systems, business machines, radio and record listening, broadcasting, and nearly any other application. Weighing only 1.2 oz., it is complete with 5' cord and standard phone plug. Sensitivity is 88 db above .0002 dynes per sq. cm. for 10 microwatts input. Frequency respon[se]: 100 to 6500 cycles.

Stock Number	Catalog Number
#18133—MONOSET, 128 ohm, complete, std. cord	HMY-2
#13184—MONOSET, 2000 ohm, complete, std. cord	HMY-2
#13135—MONOSET, 128 ohm, with volume control cord	HMY-7
#18136—MONOSET, 2000 ohm, with volume control cord	HMY-7
#13110—MONOSET, 128 ohm, NO CORD	HMY-01
#13165—MONOSET, 2000 ohm, NO CORD	HMY-01
# 9241—CORD, Standard (for metal monoset)	CMT-2
# 3280—CORD, Standard (for plastic monoset)	CMM-2

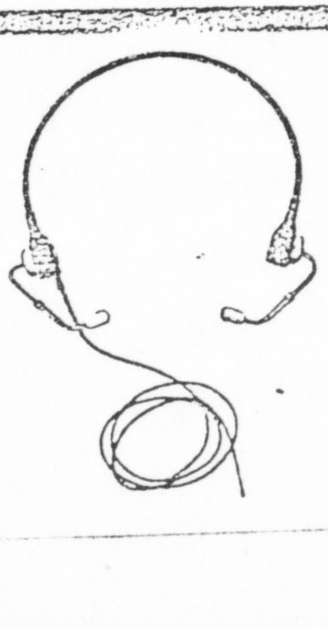
TELEX

superior quality

LISTENING DEVICES & ACCESSORIES

HEADSETS, SUBMINIATURE COMPONENTS

TELEX



TWINSET® Perfect for amateur, commercial, and industrial communications, the Twinset is CAA approved and is standard equipment on airlines and priv[ate] planes. Comfort replaces listening fatigue. Adjustable tone arms pipe sound in[to] ears, blocking out background noise, yet ear-tips need not even touch user's ear. Weighs 1.6 oz. and has 5' cord and standard phone plug. Special cord with built-in miniature volume control also available.

Sensitivity is 101 db above .0002 dynes per sq. cm. for 10 microwatts input.

Stock Number	Catalog Number
#3791—TWINSET, 64 ohm imp, complete, std. cord	HTL-2
#3775—TWINSET, 1000 ohm imp. complete (CAA app.), std. cord	HTX
#3781—TWINSET, 64 ohm imp. LESS CORD	HTL
#3776—TWINSET, 1000 ohm imp. LESS CORD (CAA app.)	HTX
#2846—Volume Control Cord, 64 ohm imp	VVM-2
#2845—Volume Control Cord, 1000 ohm imp	VXM-2

Telex Brochure - Ex. 36

Ex. 36 171

ELECTRICAL HEARING AID

Filed June 29, 1961

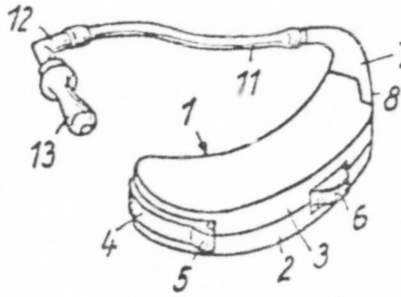


Fig.1

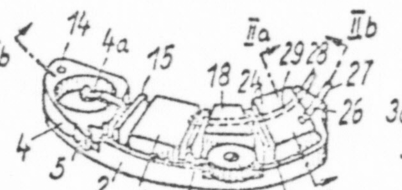


Fig.2

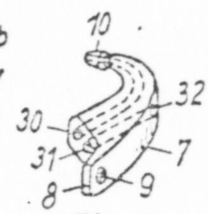


Fig.3

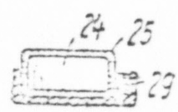


Fig.2a

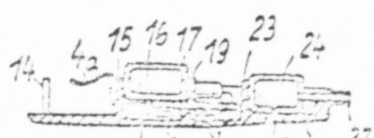


Fig.2b

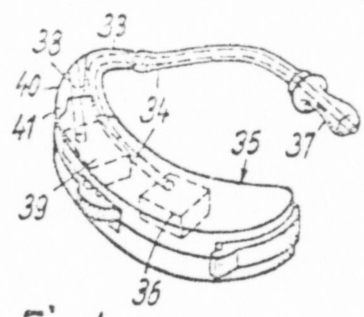


Fig.4

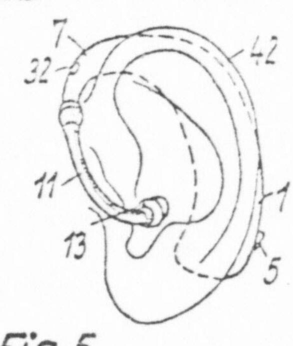


Fig.5

Ex. 38 (172)

United States Patent Office

3,209,080

Patented Sept. 28, 1965

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3,209,080

ELECTRICAL HEARING AID

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Filed June 29, 1961, Ser. No. 120,640
Claims priority, application Germany, May 12, 1961, S 73,924
7 Claims. (Cl. 179—107)

This invention is concerned with an electrical hearing aid to be worn in back of the ear, comprising a housing containing electrical components including the microphone, amplifier with regulating elements, battery and receiver, and having a hookshaped carrier portion which is free of electrical components, preferably removably connected with the housing and attachable to the upper part of the auricle.

The housing of a hearing aid which is worn in this manner, is thus positioned in back of the ear while the carrier portion extends toward the front of the ear. Accordingly, the microphone, which is disposed in the housing, is at a place lying in back of the ear. The entry or inlet opening through which the sound comes to the microphone is thereby provided as close as possible to the microphone, that is, at a place of the housing which is in back of the ear below and remote from the hooklike carrier. The sound inlet opening, also referred to as the speak-in opening, is thus frontally largely shielded by the auricle and also by the head. This is a disadvantage because sound waves generated in the course of a conversation come to the person who is hard of hearing, from the front and can be received and amplified only along a detour over a path extending in back of the ear.

The invention provides a hearing aid of the initially indicated kind, comprising means forming a sound-conducting line extending contiguous to the sound entry element of the microphone provided in the housing, such line extending to the end of the housing facing the carrier part and continuing in the carrier part or approximately parallel thereto to a microphone sound supply line which terminates in a preferably frontally visible sound inlet opening. This makes it possible that sound waves coming directly from the front can reach the microphone without going over a detour. The person hard of hearing is thus, with the use of the hearing aid according to the invention, in a better position to follow speech which a conversation partner directs at him from the front.

The hearing aid according to the invention comprises, in an exemplary embodiment, a carrier which contains in known manner an acoustic passageway forming the sound exit channel extending from the receiver to the ear piece. In addition, this carrier contains an acoustic passageway forming the sound inlet channel extending to the microphone, such latter channel terminating in the region of the greatest curvature in a frontally visible opening of the convex wall of the carrier. The carrier which is constructed in this manner is advantageously plugged to tubular studs extending respectively from the receiver sound exit line and the microphone sound inlet line forming parts of the housing. The fastening of the carrier on the housing is effected by means of an extension which may be screw connected to the housing.

The receiver is advantageously disposed in the housing about midway of the longitudinal extent thereof and the sound exit line to the ear piece is carried past a narrow side of the microphone which is positioned ahead of the receiver. The sound exit line extending from the receiver is formed by a tubular part which is flattened at least at the portion thereof which passes along the microphone.

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The flattened portion of this tubular part is thereby positioned in parallel with the narrow side of the microphone, thus providing for a space saving disposition of the sound exit line.

The various objects and features of the invention will appear from the description which will be rendered below with reference to the accompanying drawing showing in perspective representation and in sectional views examples of details of hearing aids constructed according to the invention.

FIG. 1 shows an embodiment of the hearing aid in perspective view;

FIG. 2 shows the housing with the cover detached therefrom;

FIGS. 2a and 2b show sectional views taken respectively along lines IIa—IIa and IIb—IIb in FIG. 2;

FIG. 3 shows the carrier part of the hearing aid illustrated in FIG. 1;

FIG. 4 shows in perspective view an embodiment of a hearing aid wherein the carrier is made of two parts, one part containing only the sound exit line extending from the receiver to the ear piece, while the other part contains the sound inlet line extending to the microphone; and

FIG. 5 shows a hearing aid made in accordance with the invention in its position in connection with the ear.

The acurately shaped housing 1 which is made of synthetic material is constructed of two shells 2 and 3. The housing contains a drawer 4 for receiving the battery, such drawer being pivotally journalled at 14 and being provided with a handle 5. From the convex outer wall of the housing extends part of the sound volume adjusting member 6. At the end of the housing 1 opposite the pivoted drawer 4 is disposed the carrier 7 which is curved hooklike and has an extension 8 provided with a hole formed therein (FIG. 3) through which a screw is projected for firmly fastening the carrier to the housing. The carrier terminates in a nipple 10 (FIG. 3) to which is attached a flexible hose 11 carrying an angular member 12 which in turn carries the flexible ear piece 13 to be inserted into the aural opening of the ear.

FIG. 2 shows the shell 2 of the housing with the component parts as they become visible after removal of the shell 3 and detachment therefrom of the carrier 7. Adjacent the battery drawer 4 is a partition 15 carrying the contact spring 4a, followed by the receiver 16 which is wrapped in foam rubber 17 (FIG. 2b). Next to the receiver 16 and partially thereunder are disposed parts of the amplifier 18. The amplifier parts, including also the volume control with the regulator 6, are mounted on a bracket 19. Below the bracket 19, and fastened thereto, are positioned capacitors and resistors which are schematically indicated respectively at 20 and 21, and at the portion of the bracket 19 which is next to the telephone 16, are positioned transistors 22 (FIG. 2b). Next to a partition 23, which delimits the amplifier space, is disposed the microphone 24 which is wrapped in foam rubber 25.

From the microphone 24 extends an acoustic passageway or sound inlet line 26 terminating in a tubular part 27 which projects from the housing. From the receiver 16 extends an acoustic passageway or sound exit line 29 which terminates in a tubular part 28, the latter likewise projecting from the housing. The sound exit line 29 which extends from the receiver 16 to the tubular member 28 is of oval cross-section at the portion thereof which passes along the microphone 24 (see FIG. 2a). The carrier 7 through which extend the sound channels 30 and 31, as shown in FIG. 3, is plugged to the tubular connecting members 27 and 28. The sound exit channel 30 extends to the nipple 10 to which is connected the flexible hose 11 leading to the ear piece 13, and the sound inlet channel 31

(173) (~~174~~)

(for the microphone 24) terminates in the sound inlet opening 32.

The hearing aid illustrated in FIG. 4 corresponds substantially to the hearing aid described with reference to FIGS. 1 to 3. The only difference resides in the construction of the carrier, indicated in FIGS. 1 and 3 at 7, which in FIG. 4 is made in two parts, one part 33 containing only the sound exit channel 34 leading from the receiver 36 to the ear piece 37. The sound inlet channel 38 leading to the microphone 39 extends through the other part 40 which is fastened to the housing 35 by means of an extension 41. The part 40 can also be constructed as a tube which is screw connected with the connecting tube 27 (FIGS. 2 and 2*b*), it being of course assumed that appropriate threads are provided for this purpose.

As will be seen from FIG. 5, the housing (1 in FIG. 1 or 35 in FIG. 4) is in operation positioned in back of the ear 42 while the carrier 7 (33. 40 in FIG. 4) extends forwardly of the ear 42. The sound inlet opening 32 (opening of inlet channel 38 in FIG. 4) thus comes to lie at a point which is in the use of the hearing aid directed toward the front. Sound waves directed toward the person wearing the hearing aid can accordingly directly enter at the sound inlet opening such as 32 for direct propagation without any detour, to the microphone 24 over the lines 31 and 26 (FIGS. 2 and 3) or to the microphone 39 over the line 38 (FIG. 4). The microphone converts the sound waves into electrical signals which are amplified in the amplifier such as 18 (FIG. 2) and made audible again in the receiver such as 16 in FIG. 2 or 36 in FIG. 4. The amplified sound waves are in FIGS. 1–3 conducted to the aural passage of the ear 42 over the line 29, channels 30, 11, and through the ear piece 13, while being in FIG. 4 conducted to the aural passage over the lines 34 and the ear piece 37.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

We claim:

1. An electrical hearing aid comprising a housing constructed to be disposed and worn behind the ear, said housing containing components including a battery, a microphone, an amplifier with regulation means and a receiver, a hooklike curved carrier free of electrical components, which is to be worn upon the upper part of the auricle, means forming an elongated tubular acoustic passageway for conducting sound waves from exteriorly the housing to said microphone, said acoustic passageway terminating at its outer end in a frontally directed opening near the upper part of the auricle when the hearing aid is worn, with said acoustic passageway extending rearwardly over the auricle to said microphone.

2. An electrical hearing aid comprising a housing constructed to be worn behind the ear, said housing containing components including a battery, a microphone, an amplifier with regulation means and a receiver, a hooklike curved carrier free of electrical components, which is to

be worn upon the upper part of the auricle, means for removably connecting said carrier with said housing, said housing having an elongated tubular acoustic passageway formed therein for conducting sound waves to said microphone, said carrier having an elongated tubular acoustic passageway formed therein communicating at its connection end with the f[illegible] of said first-mentioned passageway, and terminating at its opposite end in a frontally directed and frontally visible sound inlet opening, said second-mentioned passageway extending rearwardly over the auricle to said first-mentioned passageway.

3. A hearing aid according to claim 2, comprising a bracketlike portion extending from said carrier for mounting the carrier in assembly with the housing.

4. A hearing aid according to claim 2, wherein said second-mentioned acoustic passageway terminates in a sound inlet opening in the portion of the wall of said hook-like carrier which has the greatest convex curvature, said carrier also having a tubular acoustic passageway formed therein which communicates at one end, with the receiver and at the opposite end with the ear piece of the device.

5. A hearing aid according to claim 4, comprising means forming a tubular acoustic passageway for conducting sound waves from said receiver, tubular studs extending from the housing and communicating respectively with the line to said microphone and the line from said receiver, said studs extending in assembled position of said carrier into the respective acoustic passageways formed therein.

6. A hearing aid according to claim 4, wherein the receiver is disposed in said housing within a centrally extending region thereof while the microphone is disposed therein near the end thereof facing said carrier, and means forming an acoustic passageway extending from said receiver alongside a narrow side of said microphone to the ear piece of said hearing aid.

7. A hearing aid according to claim 6, comprising a tubular member disposed in said housing and forming said acoustic passageway from the receiver, said tubular member being flattened at least for the portion thereof which passes along the narrow side of said microphone, with the long cross sectional axis of said flattened portion extending in parallel with said narrow side.

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ROBERT H. ROSE, *Primary Examiner.*

STEPHEN W. CAPELLI, *Examiner.*

April 14, 1959 R. E. ERICKSON 2,882,348

HEARING AID

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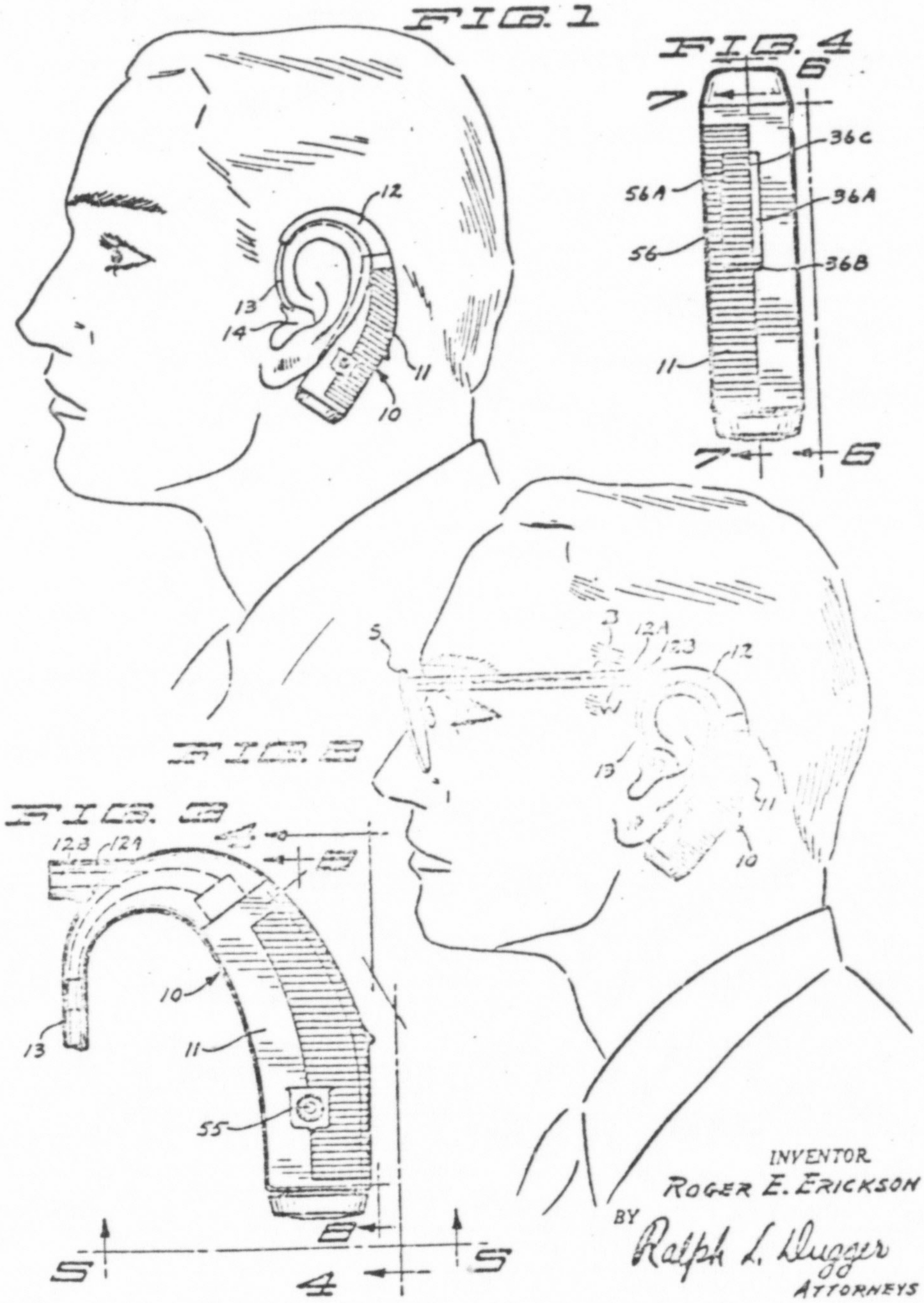

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April 14, 1959 R. E. ERICKSON 2,882,348

HEARING AID

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FIG. 6

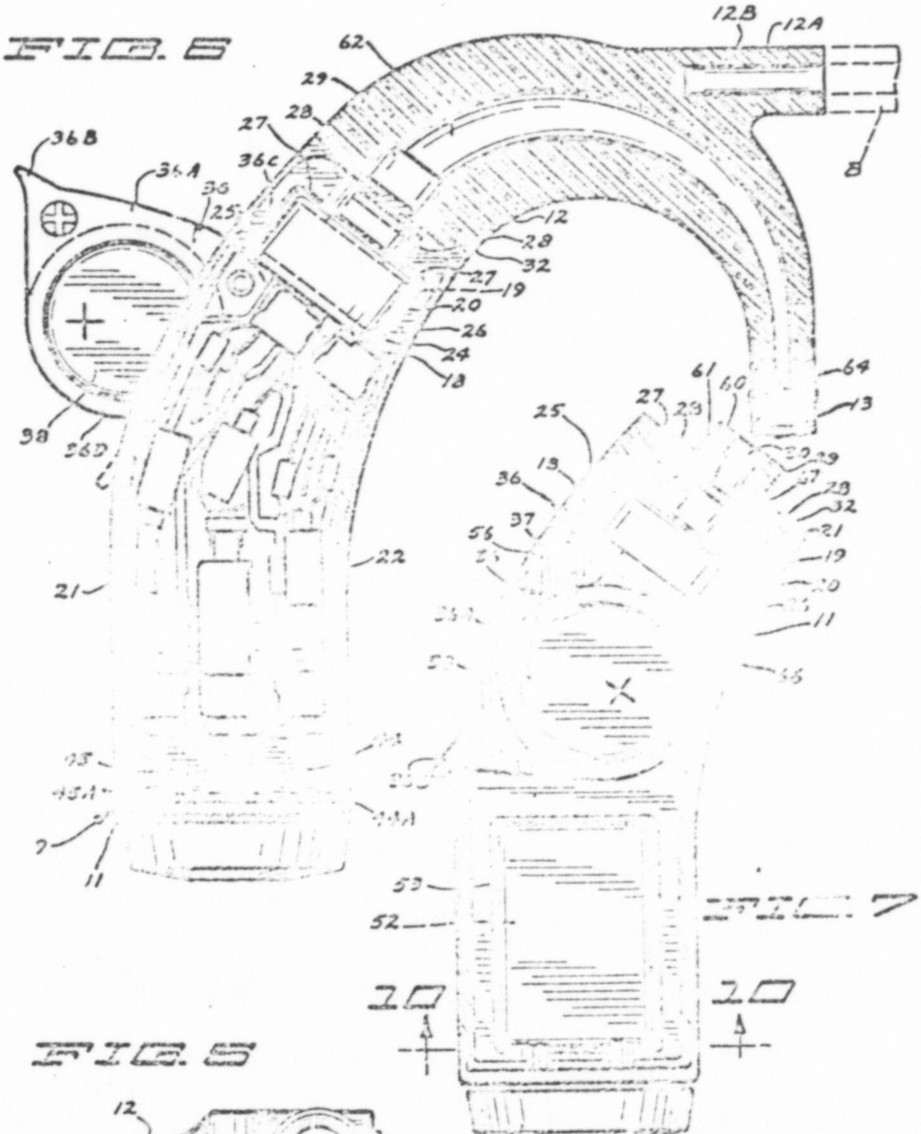

FIG. 7

FIG. 8

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HEARING AID

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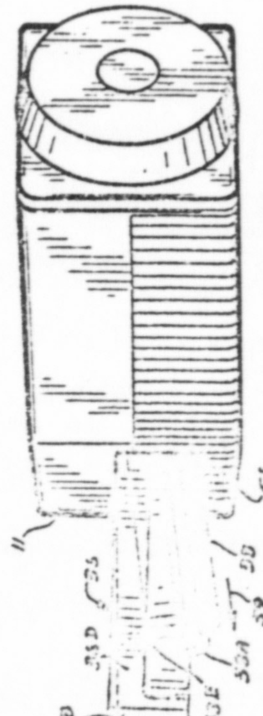

FIG. 9

FIG. 10

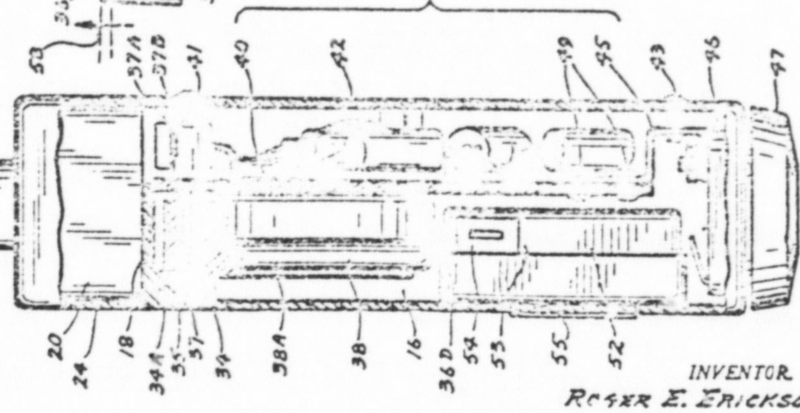

FIG. 8

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United States Patent Office

2,882,343

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2,882,343

HEARING AID

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Application July 26, 1957, Serial No. 674,343

4 Claims. (Cl. 179—107)

This invention relates to an improved self-contained battery powered hearing aid which may be worn directly adjacent and attached to the ear of the wearer, either with or without attachment to the bow of a standard spectacle. The invention relates particularly to a subminiature type of battery powered, transistor hearing aid, entirely self-contained, containing microphone and sound reproducer in mechanical arrangement so as to minimize microphonic feedback, and to provide adequate amplification of the sound frequencies normally heard by human individuals. It is an object of the present invention to provide a hearing aid of the aforesaid character and more particularly to provide a hearing aid capable of being fitted to the wearer without undue individual attention.

It is another object of the invention to provide an improved hearing aid of a shape, weight, and so constructed so that it can be worn comfortably by most individuals. It is another object of the invention to provide an improved hearing aid capable of being [illegible] readily for [illegible] the [illegible] bow of an ordinary spectacle, without any more [illegible] the spectacle bow [illegible] attach it to the hearing aid [illegible].

It is another object of the invention to provide an improved hearing aid wherein the battery is so contained as to be capable of being made available for easy access for replacement and yet so mounted that the battery cannot be readily dislodged and lost, thereby providing a structure which may be utilized easily by the elderly, and by those whose manual dexterity may be impaired. It is another object of the invention to provide an improved hearing aid which is free from interference due to fluorescent lights and the like electrical disturbances. It is a further object of the invention to provide an improved hearing aid of the design such that it can easily be made in either right or left so as to enable the bearer to mount the hearing aid adjacent either ear which may be impaired or to provide hearing aids for both ears, and thereby accomplish biaural sound reproduction for the wearer.

Other and further objects are those inherent in the invention herein illustrated, described and claimed and will be apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated with reference to the drawings wherein

Figure 1 is a side elevational view of a human individual's head showing one form of hearing aid apparatus of the present invention mounted in position on the ear of the wearer.

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Figure 2 is a side elevational view of the human head showing another form of hearing aid apparatus of the present invention in place on the ear of the wearer and attached to a spectacle bow.

Figure 3 is a side elevational view of the hearing aid apparatus shown in Figure 2 but removed from the ear of the wearer.

Figure 4 is a rear elevational view of the hearing aid apparatus shown in Figures 1 and 2 taken in the direction of arrows 4—4 of Figure 3.

Figure 5 is a bottom view of the hearing aid apparatus illustrated in Figure 3 taken in the direction of arrows 5—5 of Figure 3.

Figure 6 is a partial vertical sectional view taken along the lines and in the direction of arrows 6—6 of Figure 4. In this figure the hearing aid is viewed from that side which is normally adjacent the head of the wearer and the cover plate on this side, is removed in Figure 6. The sound tube horn, through which the sound is delivered to the ear of the wearer, is shown in section in Figure 6.

Figure 7 is a sectional view vertically (longitudinally) through the hearing aid apparatus, the sectioning being at a position and in the direction of arrows 7—7 of Figure 4. In this view the sound tube horn of the hearing aid apparatus, which delivers the sound to the wearer has been removed.

Figure 8 is a rear elevational view partly broken away taken just inside the rear wall along the line and in the direction of arrows 8—8 of Figure 3. Again, the sound tube horn which delivers sound to the ear of the wearer is removed from the hearing aid case in this view. The line of sectioning along which Figure 8 is taken is shown in Figure 3.

Figure 9 is a bottom view, looking directly upwardly, [illegible] the hearing aid case when it is in normal wearing position as shown in Figures 1 and 2. For simplicity, the horn 12 is not shown in Figure 9. Also in this figure the battery frame is swung out and is slightly deflected in one direction and the battery is cocked in the other direction, preparatory to removal of the battery.

Figure 10 is a separated sectional view of the microphone metal sheath, with the microphone within it. The microphone is not shown in section. In this view these components are shown removed from the case of the hearing aid. This view is taken in the direction of arrows 10—10 and at the position of line 10—10 in Figure 7. The hearing aid case and other components are, for simplicity, not shown in Figure 10.

Throughout the drawing the same numerals refer to corresponding parts of the apparatus.

Referring to Figure 1 there is illustrated a hearing aid generally designated 10 shown attached to the ear of the human wearer. This hearing aid includes a body portion 11 and a detachable horn 12 which is attached at its small end to a clear flexible plastic tube 13 that in turn is attached to a plastic "earmold" 14 that is individually fitted to the wearer. The horn 12 is tapered and is press-fitted to tubular bars 29 on case 11, see Figures 6 and 7. The horn 12 is composed of a plastic material such as polyethylene plastic and has a moderate amount of flexibility, a good smooth "feel" and due to such flexibility is easily attached by frictional engagement to the harder plastic case, as shown particularly in Figures 6 and 7 to which reference will be made. The horn 12 has a tapered hole 62 through it for conducting the sound and the exterior of the horn also tapers out to end 64, where provision is

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made for receiving the plastic tube 13, slipfitted to the end 64.

In Figure 1 the hearing aid 10 is shown attached to the left ear of the wearer but it will be understood that the apparatus may be made in either a "right" or "left" form and used for either ear of the wearer. The hearing aid is entirely self-contained and needs no exterior battery supply or microphone. The horn 12 may be made in the form shown in Figure 1, in which no provision is made to attach it to a cut-off end of a spectacle bow, or it may be provided with a boss 12A having hole 12B in it for fitting to the bow B of a spectacle as in Figures 2 and 6.

Thus in Figure 2 the hearing aid 10 and body portion 11 are identical to those shown in Figure 1 but the horn 12 has a protuberance 12A which is cast integral with the horn 12. This protuberance is apertured at 12B for a moderate depth, so as to receive the stiffening wire W which is normally used in the bow B of the spectacle S, as shown in Figure 2. The only necessity for fitting the horn 12 to a pair of spectacles is to snip off the spectacle bow, and strip back the plastic portion. The protuding wire W of the bow is then pushed into the aperture 12B. Any suitable adhesive is used to then cement the wire reinforcement W into the aperture 12B and the horn 12 is accordingly attached to the spectacle bow B and is carried therewith. This in effect makes the hearing aid 10 a part of the spectacle, by mere attachment thereto, added stability of wearing is thereby provided. However it should be understood that the hearing aid may be worn with sufficient stability as shown in Figure 1 because the horn 12 encircles the top of the ear and the hearing aid body 11 fits as a suspended unit closely behind the ear of the wearer. The small plastic tube 13 comes down in front of the ear and curls into and is attached to the earmold 14. While the tube 13 has some degree of flexibility and the horn 12 has a slight degree of flexibility, particularly towards its small end where it is attached to the tube 13, nevertheless the earmold attachment and the entire configuration of the unit serves to hold the unit with reasonable and entirely sufficient attachment to the ear of the wearer as shown in Figure 1, even where no attachment is made to a spectacle bow. Some users prefer the form of the device shown in Figure 2 where the horn 12 is attached to the bow of the spectacle but this is not required for complete stability of the unit or for wearer comfort.

The horn 12 may be made as a solid boss and the portion 12A may be left unbored, and the agent who fits the hearing aid will then drill out the protuberance 12A to fit the diameter of the reinforcing wire W in the spectacle bow B, if that type of spectacle is to be attached thereto, or where a spectacle of the type having a metallic bow is used the protuberance 12A may be drilled to fit the particular diameter size of the spectacle bow wire and the latter may then be cemented firmly in place.

Referring particularly to Figures 3 through 9 the case 11 is a plastic molding formed so as to provide an interior space 16 which is of maximum depth throughout the portion from the bottom wall 17 to the wall 18 which defines the surface against which the sound reproducer 19, encased in a very soft rubber or plastic receptacle 20 is adapted to be positioned as shown in Figures 6, 7 and 8. The shape of the interior space 16, as viewed in Figure 6, is defined by the rear wall 21, the bottom wall 17, the wall 22, which is the surface that is normally adjacent the ear of the wearer, and the interior corner 18. The upper portion of the plastic molding 11 is then provided with a pocket at 24 which extends from the interior corner 18 and between the two walls 25 and 26 to the shoulders 27—27 and then extends into a pocket of smaller width at 28—28. Finally this smaller pocket terminates at a tubular nipple at 29 having an axial hole 30 therein. The tubular nipple connects with a pocket of corresponding size in the horn 12 and the horn has a push fit onto and seats on the nipple 29 and against the surface 32 of the plastic case. Adhesive may be used to hold the horn 12 attached to the case 11 at the nipple 22 and surface 32 if desired although normally the slight flexibility of the plastic of which the horn 12 is made is sufficient to provide a lasting gripping action sufficient to hold both parts together.

The aperture 16 is provided with an interior boss 34 at one corner into which there is molded a metallic screw anchor 35. This boss 34 provides a surface 34A upon which a battery frame generally designed 36 is adapted to be mounted by means of the screw stud 37 which serves as a pivot about which the frame 36 may be swung from the position shown in Figure 7 to the position shown in Figure 6. In the position shown in Figure 7 the frame 36 holds the battery 38 in electrical contact with appropriate contacts within the hearing aid case 11 and hence provides the electrical supply for the hearing air apparatus. When the frame 36 is swung to the position of Figure 6 the battery 38 can be taken out by deflecting the frame 36 and case 11 a little, as shown in Figure 9, but battery 38 will not fall out of its own accord. It may be noted parenthetically that a single mercury type cell forms the battery 38 and this provides sufficient power to energize the transistor amplifier circuits of this hearing aid apparatus.

The transistor amplifier is mounted upon a printed circuit board 40 which is anchored in place by an enlarged head 37A on the same stud 37 which holds the battery frame 36 in place in the apparatus. The stud 37 is provided with a screw threaded aperture 37B at its outer end to which a screw 41 may be attached for holding one corner of the removable cover 42 in place on that side of the case 11 which normally contacts the head of the ear. Other corners of the case are held by screws 43—43 which are [illegible] into the metallic brackets 44 and 45 at the lower end of the housing, these brackets being provided with screw threaded apertures at [illegible] and [illegible]. The brackets 44 and 45 also serve as electrical connectors to a rheostat and switch 46 having a disc-like control knob 47. The brackets have a [illegible] shown in Figure 8 and [illegible] at 49 to the printed circuit board 40 [illegible] in the case 11.

Also there are a plurality of circuit components shown opposite the bracket 44, on the right side of the printed circuit board 40 as shown in Figure 8. These individual circuit components include the transistor, condensers, resistors, etc. making up the multiple stage transistor amplifier circuit of the hearing aid. In the hearing aid assembly when the circuit board 40 is held in place as illustrated, there is a space behind it as shown in Figure 6, and to the left of the element 40 as shown in Figure 8. It is into this space, which is illustrated in Figure 7, that the battery frame 36 swings and carries the battery 38 and thus brings the battery into position so as to form its electrical contact with the suitably disposed contact pieces on the hearing aid board 40 and elsewhere within the space 16. At the bottom of this space there is also the microphone apparatus 52 which is entirely ensheathed in magnetic material 53. The magnetic sheath 53 is made in the form of two pans which nest together as shown in Figure 10, and enclose the entire microphone except for openings as at 54 through which the electrical connections emerge from the microphone 52. The sheath 53 is of highly permeable magnetic material but the sheath is quite thin and the sound waves, which enter the case portion 11 through a small opening 55, see Figure 3, impinge against the adjacent flat surface of the microphone case metal 53 and by vibrating such case serve to operate the microphone 52 which is entirely encased by the metal case 53. The effect of this is that while the mechanical force of the sound waves are permitted to operate the microphone without substantially decreasing their effect in passing through the

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case 53, still at the same time any magnetic disturbance in the region of the microphone 52 is shielded away from the microphone by means of the magnetically permeable metal forming the case 53. This serves to reduce that kind of noise interference which has been found to be due to the proximity of the hearing aid to electrical apparatus such as fluorescent lights, etc.

Referring to Figures 6–9 particularly, it will be noted that the frame 36 which serves as a swinging mounting for the battery 38 has a maximum thickness at the wall portion 36A which is exposed to the rear of the hearing aid case 11 when the frame 36 is swung closed as shown in Figures 4 and 7. This wall portion 36A terminates as a small projection 36B at the corner opposite the pivot screw 11 and the user may accordingly insert a fingernail behind the portion 36B for swinging the frame 36 outwardly to the position shown in Figure 6. The frame portion 36A is of slightly narrower width at the corner and the small aperture 56 in the rear wall of the hearing aid case 11 is likewise somewhat narrowed at its upper portion 56A. The remainder of the frame 36 is considerably thinner and forms a ring 36D, which is displaced to the position shown in Figure 8. Accordingly, the battery, which has a [illegible] diameter flange 38A at one face, may seat with [illegible] portion of the battery case positioned in the ring 36D [illegible] the flange 38A resting on [illegible] surface of the ring. When the frame 36 is swu[illegible] outward limiting position as shown in Figure [illegible] portion of the battery 38 is still situated w[illegible] the opening 56 and the battery 38 will therefore not simply fall out of the frame 36. This is an advantage for [illegible] users of hearing aids, particularly older people, may swing the frame 36 to its open position, either through curiosity or a [illegible] battery is not operating properly, or for [illegible] battery 38 is able [illegible] to fall out of [illegible] when the frame 36 is in an open position, the battery could be [illegible] [illegible] and [illegible] roll to some place where it [illegible] for the user. According to the present [illegible] of [illegible] batteries is [illegible] frame 36 so that, while it permits the removal of the battery by a conscious act, yet the battery does not simply fall out of the frame when the frame 36 is moved to its open position. Hence as shown in Figure 6 and in Figure 9 the battery is ready to be removed but in order to do so the frame 36 must be [illegible] in the direction of arrow 58 as shown in Figure 9. This is possible due to a slight looseness of fit of the pivot bearing 37 in respect to the frame 36 and also due to the fact that the case 11 and the frame 36 are made of slightly flexible plastic material and the frame 36 when moved to its open position and is then pushed sideways in the direction of arrow 58 will deflect the case 11 a little bit. This provides enough room so that, in the position shown in Figure 9, the battery 38 may be cocked to the position shown in that figure, where the edge 38E is just ready to clear the hole in the battery frame 36 and the battery can then be withdrawn in the direction of the arrow 59. This is not at all difficult to do but it does require a conscious act of the user and in so doing the user is prevented from losing the battery through mere casual or inattentive opening of the battery frame 36.

Referring to Figures 6, 7 and 8, particularly, the sound reproducer or "receiver" 19 may be of the crystal or magnetic type and is enclosed in its usual case. Around the case, however, there is placed a [illegible] soft plastic sheath 20 which is in the form of a cup or collar, and is provided with an aperture 60 at one side, in alignment with the sound delivery tube 61 of the sound reproducer 19. Accordingly sound produced by receiver 19 can leave the tube 61 and proceed through the aperture 60 to the aperture 30 in the tubular connection 29 and thence enter the horn 12 and proceed through the gradually tapered curved aperture 62 and be delivered at the connection end 64 where attachment of the horn is made to a plastic tube 13 as previously described. The sound is then conducted through the plastic tube 13 to an "earmold" 14 which is of a shape that fits the external portions of the ear canal of the user.

The very soft plastic or rubber sheath 20 entirely surrounds the sound reproducer 19 and is provided with a flange 66 by which the back side of the sound reproducer is separated from the adjacent portions of the case 11 and the end surface of the hearing aid circuit board 40. Accordingly the mechanical conduction of sound vibrations from the receiver 19 to the microphone 52 are minimized to an unobjectionabl degree. At the same time the sound waves delivered by the sound reproducer 19 are sealed by the flange end 67 of the sheath 20 and these are not permitted to travel around through the air within the case to the microphone 52. Accordingly the sound waves are delivered and conducted through a sealed mechanical channel which begins at the sound delivery tube 61 of the sound reproducer 19 and thence enters through the port 30 of the nipple 29 and through the channel 62 of the horn 12 and through the tube 13 to the earmold 14 and being thus delivered directly to a soft portion of the ear canal and in sealed relation to the walls of the canal, very little sound is accordingly transmitted through the open air back to the microphone 52 and the sound reproducer 19 are in close mechanical proximity but with objectionable feedback either mechanically or through the air from the sound reproducer to the microphone.

As many widely apparently different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments herein.

What I claim is:

1. A hearing aid comprising a case of slightly flexible material, [illegible] system in said case [illegible] sound reproducer, [illegible] being characterized in that said case is provided with a battery holder of generally planar shape mounted to the case for movement edgewise from an operating position where the holder is within the case to a battery changing position where the holder is partially exposed outside of the case, said holder being shaped for receiving said battery therein when the battery is moved in a direction generally normal to the plane of said holder, said holder being shaped so that the battery when held therein is only partially exposed when the holder is moved with reference to the case to the battery changing position, said holder in said position and said case being deflectible relative to each other to a position such that the battery may be cocked to a position out of the plane of said holder and withdrawn from the holder and said case.

2. The hearing aid apparatus specified in claim 1 further characterized in that said battery holder is pivotally mounted on said case for swinging movement from its operating to its battery changing position.

3. The hearing aid apparatus of claim 1 further characterized in that said battery holder includes a small projecting section which overlaps the case when the battery holder is in its operating condition so as to enable the user thereof to insert an object behind said projecting section for operating said battery holder.

4. A hearing aid apparatus comprising a case of material such that magnetic waves may pass therethrough, said case including a complete electrical sound receiving and amplifying system including a microphone, a multiple stage electrical amplifier and a sound reproducer complete with power supply therefor, said apparatus being

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connected in that the case includes an aperture through which sound vibrations from the exterior may enter the case and further characterized in that said microphone is housed in a sheath of paramagnetic material, said microphone in its sheath being positioned so that a surface of the microphone which normally receives the sound waves thereagainst and which is covered by said sheath is positioned in the case adjacent the aperture therethrough, said paramagnetic material sheath being sufficiently thin adjacent said aperture so as to permit the sound waves to be transmitted directly to the sheath to the microphone within the sheath.

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PLAINTIFF'S EXHIBIT 41

ACOUSTIC MEASUREMENTS

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and
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Massachusetts Institute of Technology

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the effects of diffraction around the head and resonance in the ear canal are corrected for, there still remain discrepancies. It appears that for a given pressure *measured in both tests at the eardrum* a free-field wave produces a loudness greater by 6 to 10 db than that produced by an earphone bearing against the pinna. The nature of this difference is not understood, but it seems to be a physiological or psychological phenomenon. It has been observed by several laboratories, and it may be part of the reason for the difference between the minimum audible field and minimum audible pressure threshold curves currently published.[11] Until the validity of one or the other of the measurements is established, the one used for obtaining the real-ear response should be clearly stated when data are presented.

A. Eardrum Pressure Method

In this method the ear is used only as a passive acoustic impedance for terminating the earphone. The pressure is measured directly at the eardrum by means of a small, flexible probe tube attached to the input of a pressure microphone.[10, 12] Details of the construction of two suitable probe tubes are shown in Figs. 16·14 and 16·15.[12, 13] Associated with it is a mechanism for clamping and supporting the head of the subject and the microphone preamplifier. One possible arrangement is shown in Fig. 16·16.[13]

The probe tube is calibrated by terminating it in a small chamber coupled to the diaphragm of a calibrated standard (see Fig. 16·17).[12] The coupler shown there is cylindrical and has a volume of about 3 cc. One of the condenser microphones acts as a sound source. The calibration is done as follows: The pressure produced with the coupler is first measured with the standard microphone. Then the standard microphone is removed, and

[11] S. S. Stevens and H. Davis, *Hearing*, John Wiley and Sons (1938). The observations referred to above were made in the Bell Telephone Laboratories and at the Electro-Acoustic and Psycho-Acoustic Laboratories at Harvard.

[12] R. H. Nichols, Jr., R. J. Marquis, W. G. Wiklund, A. S. Filler, D. B. Feer, and P. S. Veneklasen, "Electro-acoustical characteristics of hearing aids," O.S.R.D. Report 4666, Electro-Acoustic Laboratory, Harvard University, May 1, 1945. This report is not available to the public.

[13] "Hearing aids and audiometers," Special Report 261, 1947 Medical Research Council. Procure from His Majesty's Stationery Office, London, England, 1 shilling, 3 pence (26 cents).

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the probe tube, mounted as shown in the right-hand part of Fig. 16·17, is inserted in its place.

For very small-sized probe tubes (inside diameter = ca. 0.025 in.), the pressure in the cavity will remain unchanged when the substitution is made. If desired, we can determine approximately the difference in the pressure (if any is measurable) before and after the substitution by means of a third probe tube and microphone inserted permanently into the side of the coupler.

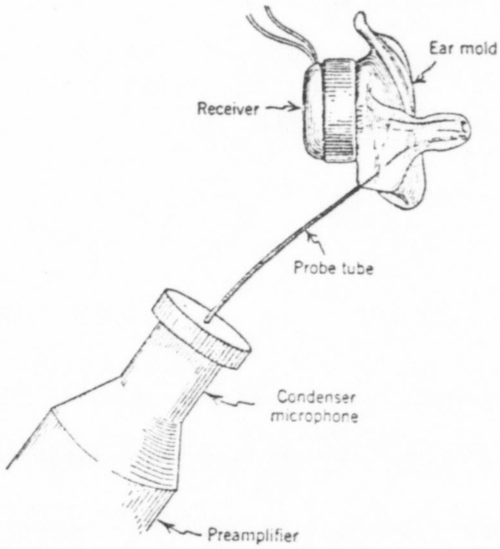

Fig. 16·14 Probe tube suitable for determining the sound pressure produced by a hearing-aid earphone near the eardrum. (After Nichols *et al.*[12])

A typical calibration curve of the correction which must be applied to the response of a 640-AA condenser microphone after addition of a 4.5-in. probe tube is shown in Fig. 16·18. This curve is so drawn that it should be subtracted from the pressure response curve of the condenser microphone to obtain the response characteristic of the overall combination.

Measurement of pressure at the eardrum is accomplished with the apparatus of Fig. 16·16. The 3-in. length of tubing shown in Fig. 16·14 is extended by adding it to a 2-in. length of flexible plastic tubing of about $\frac{5}{64}$-in. outer diameter.[10] To permit easy

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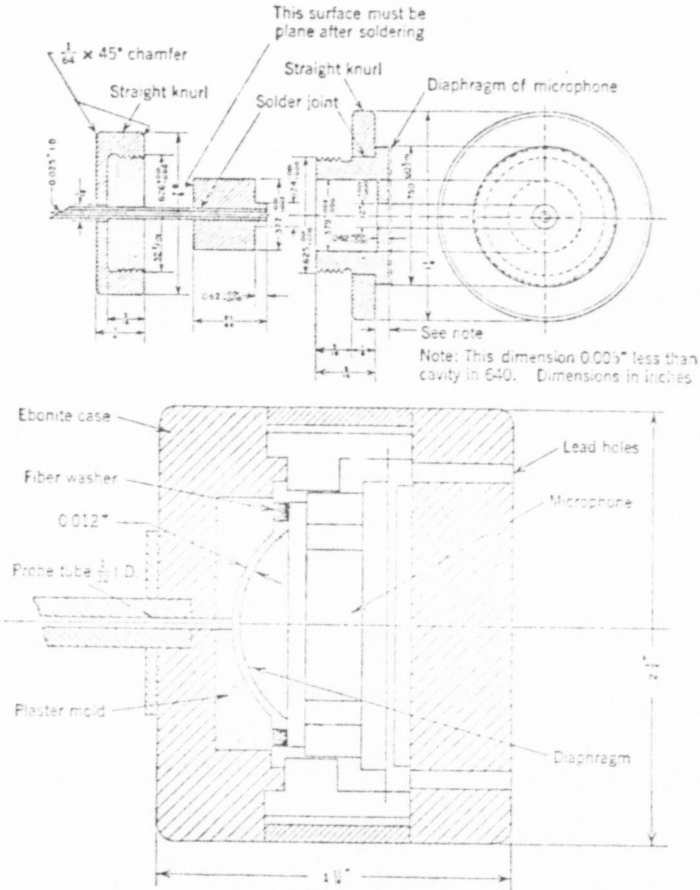

Fig. 16·15 (*Above*) Attachment for joining probe tube to standard condenser microphone. (After Nichols *et al.*[12]) (*Below*) Attachment for joining probe tube to dynamic microphone (from Ref. 13.)

and accurate insertion of the probe tube into the ear canal, the microphone holder must be mounted on a special adjustable carriage. The one shown in Fig. 16·16 is designed to permit vertical adjustment by means of a lead screw, lateral adjustment roughly parallel to the length of the ear canal by means of a rack and pinion, and motion approximately perpendicular to the ear canal

Fig. 16·16 Head clamp and microphone with flexible probe tube for sound pressure measurements in the ear canal under an earphone cushion. (After Wiener and Filler.[10])

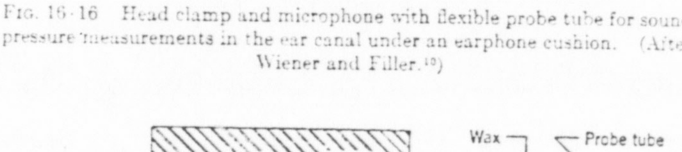

Fig. 16·17 Calibrating chamber for a probe tube of very small diameter. The sketch at the left shows a condenser microphone being used to measure the pressure in a cavity. This pressure is produced by a second condenser microphone driven as a source. After the pressure is determined, the right-hand microphone is removed from the cavity and the probe tube and its holder are inserted. (After Nichols et al.[12])

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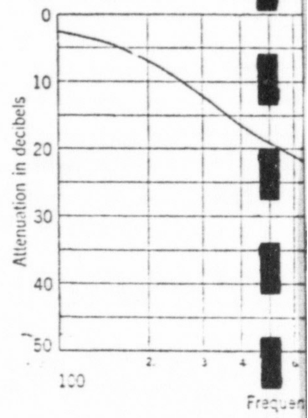

Fig. 16·18 Typical calibr on
diameter of about 0.025 in.
640-AA microphone. This curv
response curve for the 640-AA mi
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B. Outer Ear Canal Meth

For safety, we usually me
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by means of another lead screw. The carriage is anchored to the main rod supporting the head clamp. The end of the probe tube is located near the eardrum by advancing it cautiously into the auditory canal until the person reports an auditory sensation approximating a dull thud. After a slight withdrawal, the sound pressure is measured as a function of frequency.

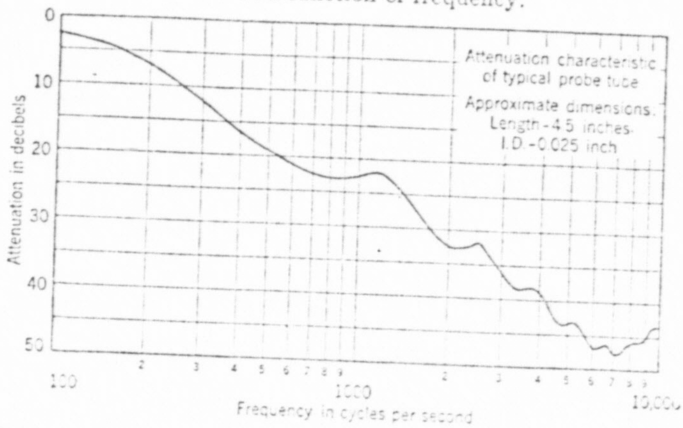

FIG. 16-18 Typical calibration curve for a probe tube having an inside diameter of about 0.025 in. and a length of 4.5 in. when attached to a W.E. 640-AA microphone. This curve should be subtracted from the pressure response curve for the 640-AA microphone itself. The rise in pressure above 7000 cps is probably an artifact. (After Nichols et al.)

B. Outer Ear Canal Method

For safety, we usually measure the sound pressure in the outer ear and convert it to pressure at the eardrum. For earphones fitted to cushions that bear against the ear, the probe tube is located as follows: The end of the probe tube is pushed through the rubber walls of the earphone cushion (see Fig. 16-19) and is adjusted so that its tip lies in a plane through the face of the earphone and near its center.[10] In earphones with rubber tips that extend part way down into the ear canal, the end of the probe tube is made to coincide with the plane through the end of the tip.

For converting from pressures measured at the cushion to pressures at the eardrum, the curve given in Fig. 16-20 may be used.[19] In some cases, the ratios of the pressures in a free sound field to those generated at the eardrum of a person after he enters the

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the chamber, which in turn produces an alternating change in pressure through the chamber. Air at atmospheric pressure confined in a small volume is quite stiff. A stiffness-controlled (compliant) diaphragm forming part of a wall of a small chamber substantially reduces the pressure rise which accompanies a given volume change. In this sense the compliant diaphragm acts like an extra volume of air; therefore impedance is often expressed in terms of cubic centimeters of air at atmospheric pressure. Resistance-controlled and mass-controlled diaphragms have impedances which can also be expressed in cubic centimeters of standard air, but the number of cubic centimeters for these diaphragms is inversely proportional to the first or second power of the frequency, whereas for stiffness-controlled diaphragms the number of cubic centimeters is independent of frequency.

Probe Microphones. In many acoustic measurements, it is necessary that a very small microphone be used in order not to disturb the sound field appreciably. Such microphones are generally constructed by adding a small probe tube to a larger sized microphone. As one looks into the end of such a probe tube the acoustic impedance will be equal to that calculated for the tube terminated by the impedance of the microphone and its coupling chamber.

A typical arrangement for a probe tube[5] is shown in the upper part of Fig. 16·15 on p. 733. There a probe tube of 0.025-in. inside diameter is connected with a W.E. 640-AA condenser microphone whose characteristics are given in Section 5·4C. As can be seen from the calibration curve of Fig. 5·6 suggestions of resonances appear at several frequencies. If the bore of the tube were larger, these resonances would become more pronounced. For tubes wherein the diameter is small enough that the resonances are suppressed, the *added* attenuation produced by an increment in length may be estimated from the formulas which follow.

Rayleigh[6] gives the following formula for the real part of the

[5] R. H. Nichols, Jr., R. J. Marquis, W. G. Wiklund, A. S. Filler, D. B. Feer, and P. S. Veneklasen, "Electro-acoustical characteristics of hearing aids," Section I, O.S.R.D. Report 4666, Harvard University, Cambridge, Massachusetts. This report is not available to the public.

[6] Lord Rayleigh, *Theory of Sound*, §350, Vol. 2, p. 325, Macmillan and Company, Ltd. (1940).

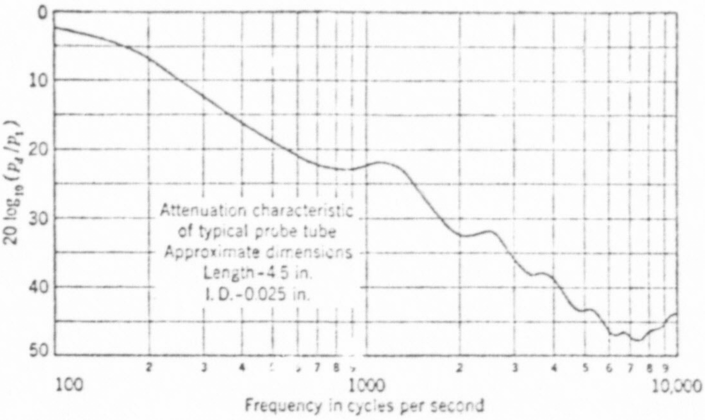

FIG. 5·6 Calibration curve for probe tube of the upper part of Fig. 16·15, p. 733, to be subtracted from basic calibration curve for W.E. 640-AA microphone. (Courtesy R. H. Nichols, Jr.)

propagation constant for tubes which are not too small in diameter:

$$\text{Attenuation constant} = \frac{\sqrt{2\omega}}{cd}\left[\sqrt{\nu} + (\gamma - 1)\sqrt{\frac{\alpha}{\gamma}}\right] = \frac{A}{\sqrt{\lambda}\, d} \quad \text{nepers/cm} \qquad (5\cdot1)$$

where d = diameter of tube, in centimeters

λ = wavelength of sound, in centimeters

ν = kinematic coefficient of viscosity, in square centimeters per second (see Chapter 2)

c = velocity of sound, in centimeters per second

γ = ratio of specific heats for air = 1.4

α = coefficient of temperature exchange, in square centimeters per second (see Chapter 2)

ω = angular frequency = $2\pi f$

A = constant for the particular gas, ambient pressure, and temperature existing; for air at 17°C, A = 0.0108.

For very small capillary tubes, Rayleigh gives

$$\text{Attenuation constant} = \frac{4\sqrt{\nu\omega\gamma}}{cd} = \frac{B}{\sqrt{\lambda}\, d} \quad \text{nepers/cm} \qquad (5\cdot2)$$

For air at 17°C, the constant
be used when $\sqrt{4\pi\nu/f}$ is con
For air at 17°C this quantity
to decibels per centimeter th
plied by 8.69.

May[7] gives experimental d
capillary tubes at ultrasonic

T

Frequency, kc	Tube Radius, cm
39.1	0.073 0.0585 0.0295
58.0	0.073 0.0585 0.0317
90.0	0.073 0.0317
115	0.073 0.0585 0.0317

lated in Table 5·2. These
times as great as those calc
(5·1) should be valid for the
which he used. Other exp
results.

5·3

Even if it were possible to
ment in which there is abso
voltage would be produced
from the thermal agitation in
impedance as measured at
For this measurement the mi

[7] J. May, "The propagation o
Phys. Soc., 50, 553–560 (1938).

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For air at 17°C, the constant $B = 0.0248$. This equation should be used when $\sqrt{4\pi\nu/f}$ is comparable to the radius of the tube. For air at 17°C this quantity simplifies to $1.4/\sqrt{f}$. To convert to decibels per centimeter the above equations should be multiplied by 8.69.

May[7] gives experimental data on the attenuation of sound in capillary tubes at ultrasonic frequencies. His results are tabulated in Table 5·2. These values are found to be about three times as great as those calculated from Eq. (5·1). Equation (5·1) should be valid for the frequency range and size of tubes which he used. Other experimenters have obtained similar results.

TABLE 5·2

Frequency, kc	Tube Radius, cm	Temp., °C	Attenuation	
			nepers/cm	db/cm
39.1	0.073	16.7	0.18	1.56
	0.0585	14.7	0.22	1.91
	0.0295	17.2	0.52	4.5
58.0	0.073	14.5	0.27	2.3
	0.0585	14.7	0.33	2.9
	0.0317	14.4	0.55	4.8
90.0	0.073	19.8	0.32	2.8
	0.0317	19.6	0.60	5.2
115	0.073	18.3	0.25	2.2
	0.0585	18.1	0.38	3.3
	0.0317	18.0	0.73	6.3

5·3 Self-Noise

Even if it were possible to place a microphone in an environment in which there is absolute quiet, a randomly fluctuating voltage would be produced at its output. The voltage arises from the thermal agitation in the resistive part of the electrical impedance as measured at the terminals of the microphone. For this measurement the microphone would need to be located

[7] J. May, "The propagation of supersonics in capillary tubes," *Proc. Phys. Soc.*, **50**, 553–560 (1938).

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(193)

A

A.D. 1878, 15th January. N° 191.

Appliances for Utilizing and Conveying Sounds or Signals from Telephonic or Sound-producing Instruments.

LETTERS PATENT to George Edward Pritchett, of Bishop Stortford, in the County of Herts, Architect, for the Invention of "NEW OR IMPROVED MEANS, APPARATUS, OR APPLIANCES FOR UTILIZING AND CONVEYING SOUNDS OR SIGNALS FROM OR TO TELEPHONIC OR PHONOGRAPHIC SOUND-PRODUCING OR SIGNALLING INSTRUMENTS."

Sealed the 22nd March 1878, and dated the 15th January 1878.

PROVISIONAL SPECIFICATION left by the said George Edward Pritchett at the Office of the Commissioners of Patents on the 15th January 1878.

GEORGE EDWARD PRITCHETT, of Bishop Stortford, in the County of Herts, Architect. "NEW OR IMPROVED MEANS, APPARATUS, OR APPLIANCES FOR UTILIZING AND CONVEYING SOUNDS OR SIGNALS FROM OR TO TELEPHONIC OR PHONOGRAPHIC SOUND-PRODUCING OR SIGNALLING INSTRUMENTS."

This Invention comprises means or methods of imparting and revealing sounds, articulate speech, musical or other sounds or signals emanating from or produced by telephonic, phonographic, and sound-producing instruments and apparatus, so as to put the sounds or signals into audible or open communication with a number of persons simultaneously. This may be effected by placing a cap, caps, or covers, or other similar appliances of suitable dimensions, construction, and materials in close connection with, or in such convenient position or positions with respect to the telephonic and phonographic instruments and apparatus as to catch the words, sounds, and signals emanating from or produced by the instruments and apparatus aforesaid. From these caps, cap, or covers a number of tubes or channels of various sizes or lengths may be branched by being inserted, screwed, or secured into the said cap or covers, or into the telephonic and phonographic instruments and apparatus, below or above the discs, and terminated or fitted with ear-pieces, mouth-pieces, and valves, or otherwise.

[Price 2d.]

Ex. 42 194

It follows, that when the telephonic and phonographic sounds, words, or signals are produced or received by the instruments or apparatus aforesaid, the tubes or channels attached to the said cap, caps, or covers, or telephonic and phonographic instruments, will convey the sounds, words, or signals emanated or signalled to a distance from the instruments or apparatus to a number of persons using the instrument where required.

Such tubes, and mouth-pieces, and ear-pieces, can also be used and attached for speaking into and listening to such instruments from a distance simultaneously, and thus authenticated copies of messages or signals sent could be taken down in writing, or listened to by persons in different places.

For example, several reporters to newspapers, or other persons, may severally have the use of one or more tubes or channels, and mouth-pieces and ear-pieces, running from the cap, caps, or covers or instruments as before mentioned, which, if adjusted or fixed to his or their persons or ears, having light ear-pieces and pads with springs, or otherwise, so as to shut out external sounds, stillness would be secured to him or them, and one telephonic and phonographic instrument, from which sounds, words, or signals emanate or are signalled, would answer the purpose of a multiplicity of telephonic and phonographic instruments and apparatus, as several persons would, one and all, be able to hear the same messages, words, or signals, or sounds at the same time, although in different places. The messages words, or signals received could thus be attested, registered, and accuracy ensured at the moment of emanation or delivery.

It will be evident that the hands of the reporters or others will be free, from not having to hold any instruments, as the tubes or channels aforesaid will be attached to or brought into close proximity to their ears, mouths, or persons from the telephonic and phonographic instruments, which could be fixed. Thus, their fingers will be free and ready to write or manipulate other instruments, apparatus, &c., as required, at the same time as the words, sounds, or signals are in emanation from the telephonic and phonographic instruments or apparatus.

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SPECIFICATION in pursuance of the conditions of the Letters Patent filed by the said George Edward Pritchett in the Great Seal Patent Office on the 15th July 1878.

George Edward Pritchett, of Bishop Stortford, in the County of Herts, Architect. "New or Improved Means, Apparatus, or Appliances for Utilizing and Conveying Sounds or Signals from or to Telephonic or Phonographic Sound-producing or Signalling Instruments."

This Invention comprises means or methods of imparting and revealing sounds, articulate speech, musical or other sounds or signals emanating from or produced by telephonic, phonographic, and sound-producing instruments and apparatus, so as to put the sounds or signals into audible or open communication with a number of persons simultaneously. This may be effected by placing a cap, caps, covers, cases or other similar appliances of suitable dimensions, construction, and materials in close connection with or in other convenient position or positions with respect to the telephonic and phonographic instruments and other apparatus, so as to catch the words, sounds, and signals emanating from, conveyed, or produced by the the instruments and apparatus aforesaid. From these caps, cap, or covers a number of tubes or channels of various sizes or lengths may be branched by being inserted, screwed, or secured into the said cap, caps, covers, or cases, or into the telephonic and phonographic instruments and apparatus, below or above the discs, and terminated or fitted with ear-pieces, mouth-pieces, valves, and circuit breaks or otherwise.

It follows that when the telephonic or phonographic sounds, words, or signals are produced or received by the instruments or apparatus aforesaid, the tubes or channels attached to the said cap, caps, or covers or telephonic and phonographic instruments will convey the sounds, words, or signals emanated or signalled to a distance from the instruments or apparatus to a number of persons using or listening to the instrument where required.

Such tubes, and mouth-pieces, and ear-pieces can also be used and attached for speaking into and listening to such instruments from a distance simultaneously, and thus authenticated copies of messages or signals sent could be taken down in writing, and listened to by persons in different places.

For example, several reporters to newspapers, or other persons, may severally have the use of one or more tubes or channels, and mouth-pieces and ear-pieces, running from the cap, caps, or covers or instruments as before mentioned, which if adjusted or fixed to his or their persons or ears (having light ear-pieces and pads with springs or otherwise, so as to shut out external sounds) stillness would be secured to him or them, and one telephonic or phonographic or other sound-producing instrument or instruments from which sounds, words, or signals emanate by being boxed or cased in, or are signalled, would answer the purpose of a multiplicity of telephonic, phonographic, or other sound-producing or conveying instruments and apparatus as several persons would, one and all, be able to hear the same message, words, or signals, or sounds from the same telephonic or phonographic instrument at the same time. The messages, words, or signals received could thus be attested, registered, and accuracy ensured at the moment of emanation or delivery.

It will be evident that the hands of the reporters or others will be free from not having to hold any instrument, as the tubes or channels aforesaid will be attached to or brought in close proximity to their ears, mouths, or persons from the telephonic and phonographic or other instruments which could be fixed. Thus, their fingers will be free and ready to write or manipulate other instruments, apparatus, &c., as [illegible]ed, at the same time as the words, sounds, or signals are in emanation from the telephonic or phonographic or other instruments or apparatus.

Having thus far described my Invention, I may remark that my new, improved, and [illegible]bined sound-producing, transmitting, and receiving instruments, apparatus,

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and appliances alluded to may be placed at any convenient distances or number of miles apart, and may be brought into use or worked by any method or medium, so as to produce the required and strengthening effects, and same may vary in size, shape, dimensions, and materials.

For the new adaptations and combinations aforesaid one mode I adopt, shewn by Fig. 1 of the Drawing accompanying this Specification, is to bend a steel or iron rod or rods, jointed or otherwise, towards or at its or their centres, or elsewhere, and supplied with or without soft iron cores and coils, bobbins, and discs, in such a curvilinear or angular manner and proportion as to allow mouth and ear pieces or caps, with finials, pads, and appliances to fit to the ear or ears and mouth of the user when placed there, so as to form both transmitting and receiving instruments or instrument to be used at the same time without shifting it or them from the ear to the mouth, or *vice versa*.

This duplex form and combination can be held by the hand or hands, or otherwise fixed, the pressure of the fingers on the jointed, bent, or straight rod or rods (which may be magnetized or otherwise) being sufficient to adjust the instrument to the ear and mouth as required.

This adjustment may also be assisted by handles or knobs on the bar or stem (as shewn in Fig. 1).

These iron or steel rods can be covered with velvet or other suitable material, or decorated, as can also the cap and tubing.

This instrument can be folded up, so as to go readily into the pocket, or into a small case or box.

To apply this duplex instrument to both the ears and the mouth another new adaptation and combination (see Fig. 2) which I make use of is to attach a second rod, mounted with mouth and ear pieces similar to those already described, and as shewn in said Fig. 2, and thus form it into a triple instrument. These caps or ear-pieces can be padded as aforesaid, and applied to the ears, so as to shut out external sounds (as also shewn in Figures 1 and 2), which will much aid the receiver in hearing sounds and messages, whilst to transmit sounds or articulate speech it will only be necessary to move or adjust the instrument by the handles at A, B, to the mouth, so as to speak into the instrument in its duplex or triple form without shifting it or them from the ear to the mouth, or *vice versa*.

In order to lighten these instruments, elastic tubing, light springs, or other materials may be introduced between the rods or parts with advantage, as also shewn in Fig. 2.

To put two or more persons into communication with this instrument or these instruments, tubes of various sizes and suitable lengths, with ear and mouth pieces, are also introduced into the caps as required (as shewn in Figs. 1 and 2).

Another new adaptation and combination is to have one or two caps and steel or iron rods, as aforesaid, so as to fit the ear or ears, and with pads or otherwise, so as to shut out external sounds. These may be connected or fixed by straps, tubes, bands, or springs, and fastened by these passing over the head and under the chin.

Tubes may be inserted in the caps, as aforesaid, both for purposes of transmitting and receiving sounds. The hands of the person or persons using this instrument, or these instruments will thus be free to write or manipulate with other instruments, as required. This method and combination is illustrated in Fig. 3.

Another new adaptation and combination (see Fig. 4) I make use of is to cap telephonic instruments with conical or segmental caps, or enclosures of other shapes, made with metal, ebonite, or suitable materials, and having a tube or tubes (elastic or otherwise) terminated with ear finials and pads to cover the ear or ears of the person using them, so as to shut out sounds. Mouth-pieces or tubes adapted for transmitting sounds or messages will be branched and fixed on the caps, and adapted for the use of the mouth (as shewn at A in said Fig. 4).

The telephonic instruments when used in this adaptation and combination can or will be fastened by a clip, strap, or otherwise to the collar or garment of the

user, either on the left or right side; or there will, by preference, be two telephonic instruments in use, one on each side (as shewn by dotted lines in Fig. 4) with caps and tubes, which may reach to the ears as aforesaid, and the two instruments be connected with a band or strap across the shoulders, as shewn, or by clips as aforesaid.

In the case of one telephonic instrument only being in use, and attached on the left or right side of the garment of the user, the tubing attached to the cap may or will be branched; or this may be done by tripod pieces or otherwise, and conveyed to the right or left ear by passing at the back of or over the head or under the chin of the user, where it will be fixed by a band or straps and supplied with pads and ear-pieces as aforesaid; thus the hands of the person or persons using the instrument, and to whom the instrument or instruments are fixed, will be free to write and manipulate with other instruments as required. This adaptation is also illustrated in Fig. 5, where only one branch piece is shewn by side elevation.

Another new adaptation and combination is to sling telephonic instruments by straps or bands, or fix them by or on a stem or spring, so that the user can bring or press the ear against one or both of them by adjustment.

Tubes can be inserted either below or above the discs, and may be used for transmitting and receiving purposes as required (and as shewn in Fig. 6).

Another new adaptation and combination (as shewn in Fig. 7) is to mount telephonic instruments, either vertically or otherwise, in or on a stand or table.

Above, or in connection with this telephonic instrument or instruments, is a circular or polygonal tube of metal or other material of any suitable or fitting size and dimensions, with outlets and branch outlets, as shewn in Fig. 7. One or more of such tubes, with outlets as aforesaid, can be lowered or adjusted to the caps or other portions of the telephonic instruments; or the telephonic instruments will be raised or lowered to or from the main tube as required, so as to utilize and convey the sounds emanating from or produced by the telephonic power by their passing into this main tube and branch tubes aforesaid, and thence into other and longer tubes (elastic or otherwise) with ear and mouth pieces as aforesaid, and as also shewn in Fig. 7.

Stops or dampers may be introduced into the main tube or elsewhere, so as to use one or more instruments at the same time (as shewn at A, Fig. 7). Persons using these tubes, to which mouth and ear pieces may or will be attached, and fixed or held to their ear, or adjusted to their mouth, by any of the methods aforesaid, will one and all hear the sounds, articulate speech, music, &c., emanating from the telephonic instrument aforesaid, of which several may be in use at the same time, whilst their hands can or will be free for writing or manipulating with other instruments or otherwise as aforesaid.

The branches or tubes not in use may be stopped by plugs, valves, or otherwise.

Another new adaptation and combination (see Fig. 8) which I make use of is to insert into the cap of telephonic instruments a piece of tubing of appropriate size, preferably about three-quarters of an inch in diameter, and spread out at its bottom end, so as to fit closely down in the caps of the telephonic instruments, whilst its upper part or end is branched into several openings to receive tubes (elastic or otherwise) for the purpose of transmitting and receiving sounds. This tubing is secured to the case of telephonic instruments, as shewn in Fig. 8. Thus one telephonic instrument only need be in use instead of several.

Another new adaptation I make use of is to cap telephonic instruments with perforated cap or caps of ebonite, metal, or other suitable material, so as to insert into it or them one or a number of tubes or channels, which can be led away from it or them, and terminated by mouth and ear pieces, so that a number of persons may use the same simultaneously, either for transmitting or receiving sounds as aforesaid. This is illustrated in Fig. 9.

Another new adaptation I make use of (see Fig. 10) is to form with ebonite, gutta-percha, metal, or other convenient substances a cover or plug fitting into the top of the telephonic instrument, and leaving one, two, or more outlets or openings

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One of the outlets can be used for transmitting, and the other or others may be fitted with tubes or channels, and mouth and ear pieces, for the purpose of listening to and receiving sounds and messages. This mode and combination is illustrated in Fig. 10.

A similar adaptation and combination may be made use of without any telephonic instrument, technically so-called, and also with what are known as toy telephones influenced by vibratory motions, visible or invisible, by inserting a tube or tubes with suitable ear and mouth pieces into the material of the instruments, so that the telephonic instrument becomes a multiplex instrument in its effects, and several persons may use or avail themselves of a number of telephonic sounds and results simultaneously without shifting the instruments.

Similar adaptations and combinations in effect may also be used or applied to phonographic or any other sounding instruments by casing, boxing, or enclosing them with materials, such as wood, ebonite, metal, or other suitable substances, so that sounds will be condensed and strengthened, and will emanate and be conveyed from them and their casings and boxings through tubes or channels to distances less or greater, as may be required, and thus sounds or signals will be put into audible, free, and open communication with a number of persons simultaneously, as also shewn in Fig. 11.

And it may be here observed that this Invention, although it will be found to be of great utility to all persons who have to use telephonic, phonographic, microphonic, or such like instruments, will also be found to be of the greatest service to persons afflicted with deafness, as even the simpler forms of sound-conveying instruments could, by the adoption of my Invention, be increased in efficiency.

Relays can also be introduced where requisite.

Having now particularly described and ascertained the nature and object of the said Invention, and in what manner the same is to be performed or carried out in practice, I hereby declare that I claim substantially as herein-before set forth and described, the Invention of new or improved means, apparatus, or appliances for utilizing and conveying sounds or signals to and from telephonic, phonographic, or other sound-conveying, producing, reproducing, or signalling instruments, wherein the use and adoption of sounding instruments with enclosings, pads, boxings, tubes, branches, ear trumpets, and terminals arranged substantially as herein-before described (although open to variation in detail as to relays or otherwise) with the view of condensing, strengthening, and utilizing, and transmitting the effect of telephonic, phonographic, microphonic, and other sound-conveying, producing, reproducing instruments, is the important point or feature.

In witness whereof, I, the said George Edward Pritchett, have hereunto set my hand and seal, this Fifteenth day of July, in the year of our Lord One thousand eight hundred and seventy-eight.

G. E. PRITCHETT. (L.S.)

Witness,
T. Morgan,
Secretary,
Inventors' Patent Right Assn., Limited.

LONDON: Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.
1878.

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A.D.1878. Jan. 15. No. 191.
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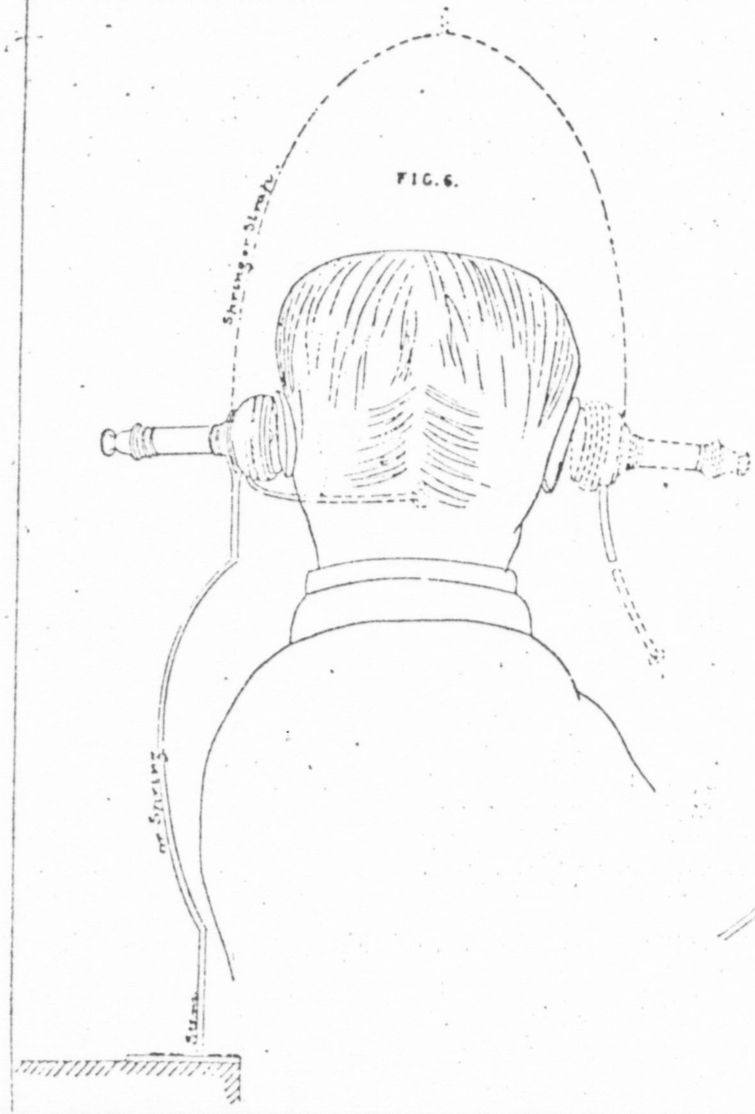


FIG. 6.

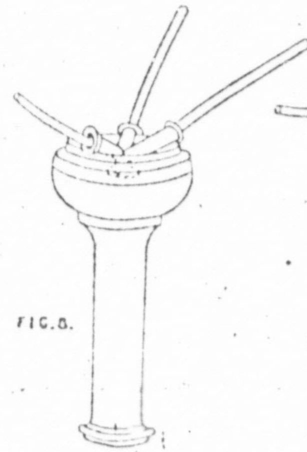


FIG. 8.

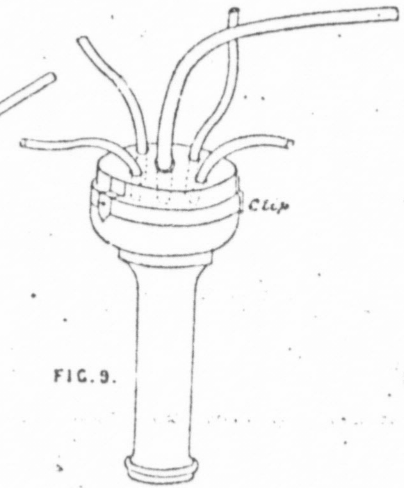


FIG. 9.

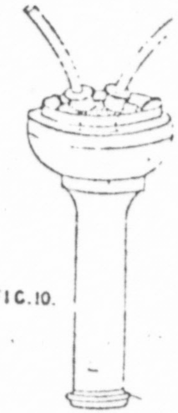
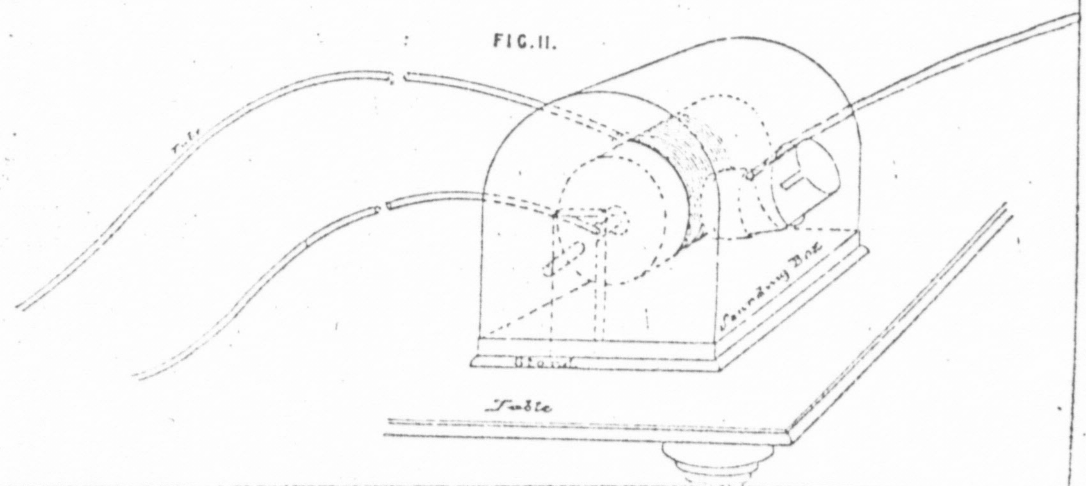


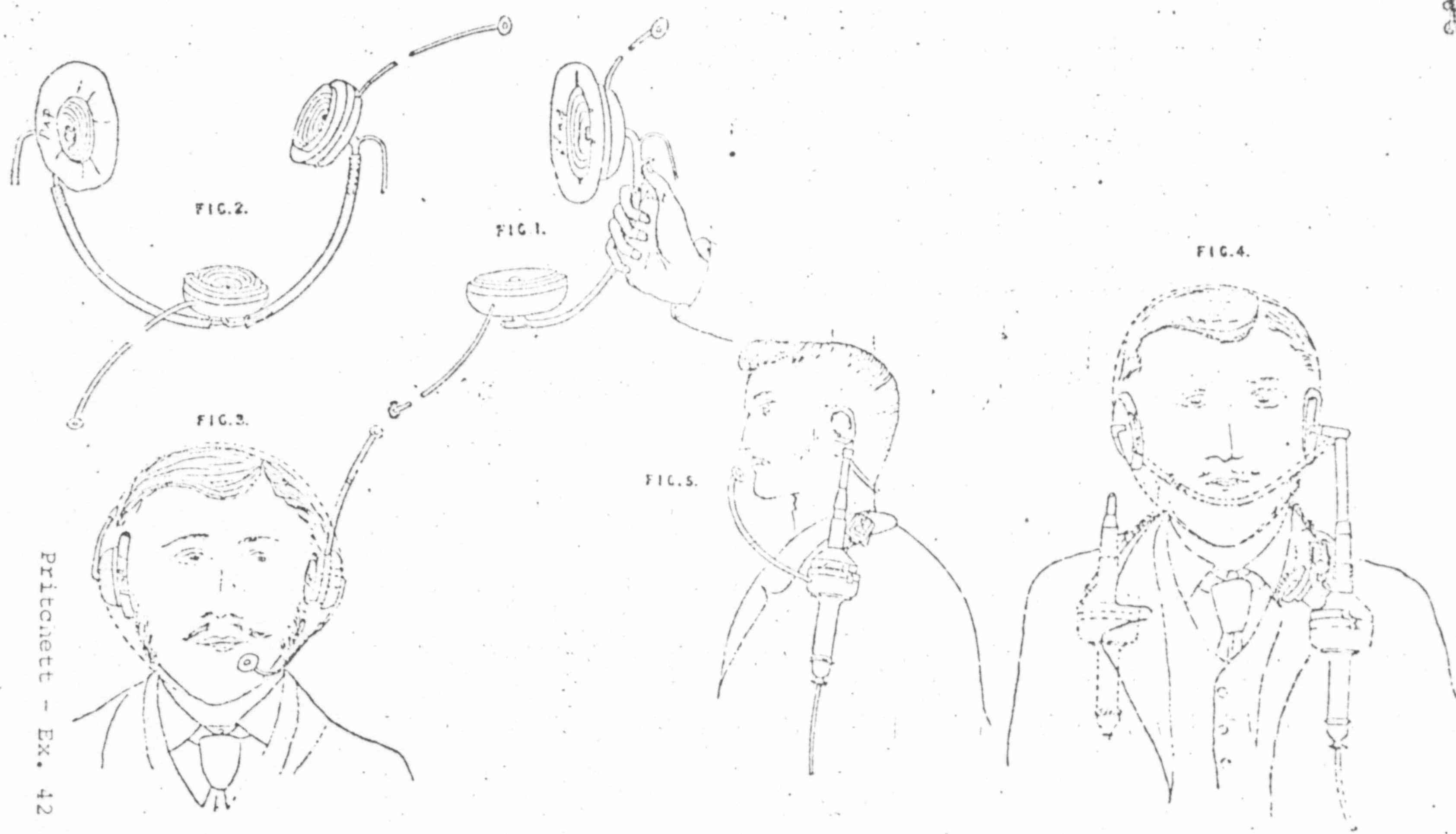
FIG. 10.

FIG. 11.



A. D. 1878. Jan. 15. No 191.
PRITCHETT'S SPECIFICATION.

(3 SHEETS)
SHEET 1



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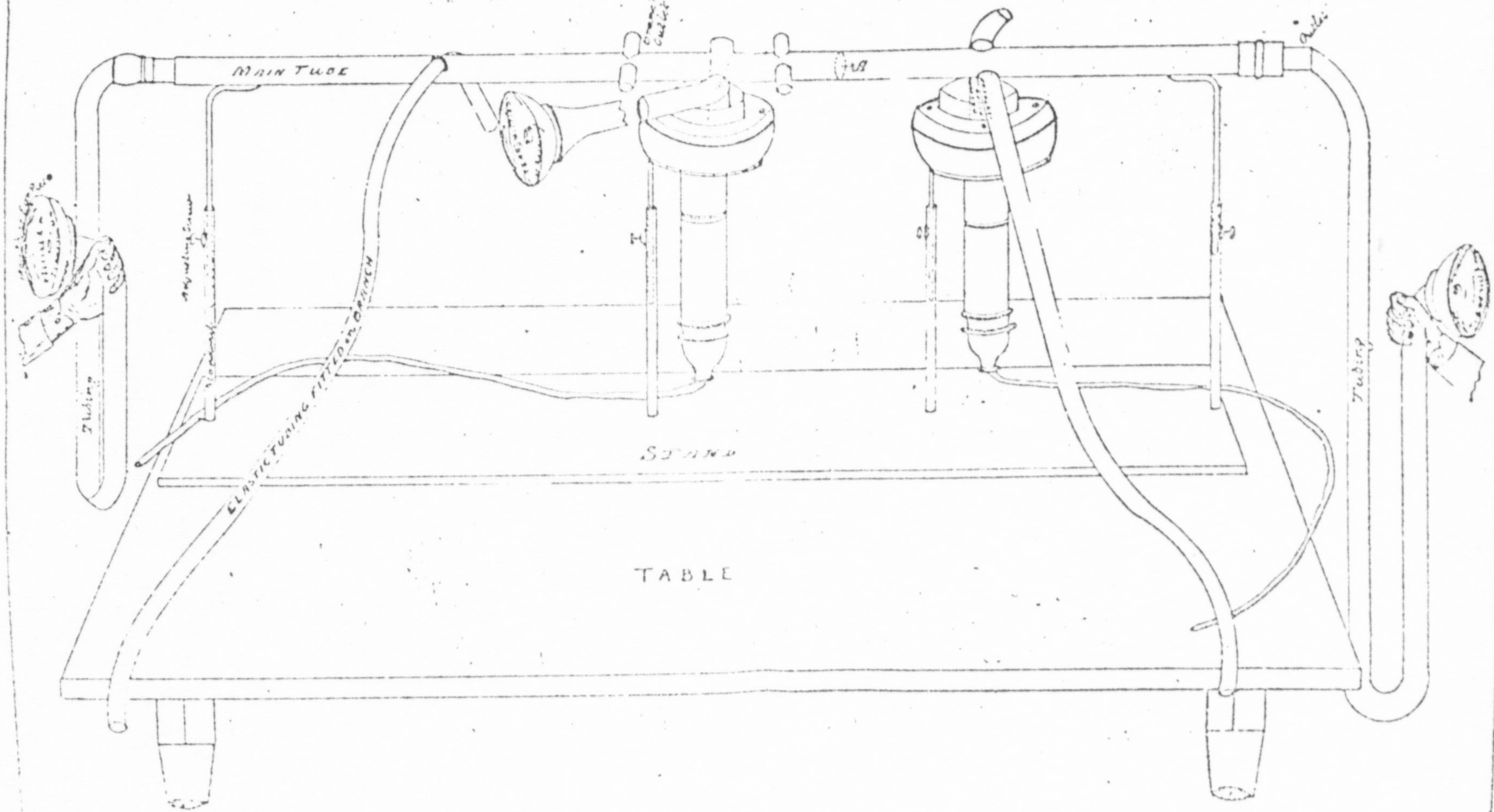
A.D. 1878. JAN. 15. N° 191.
PRITCHETT'S SPECIFICATION.

3 SHEETS.
SHEET 3.

FIG. 7.



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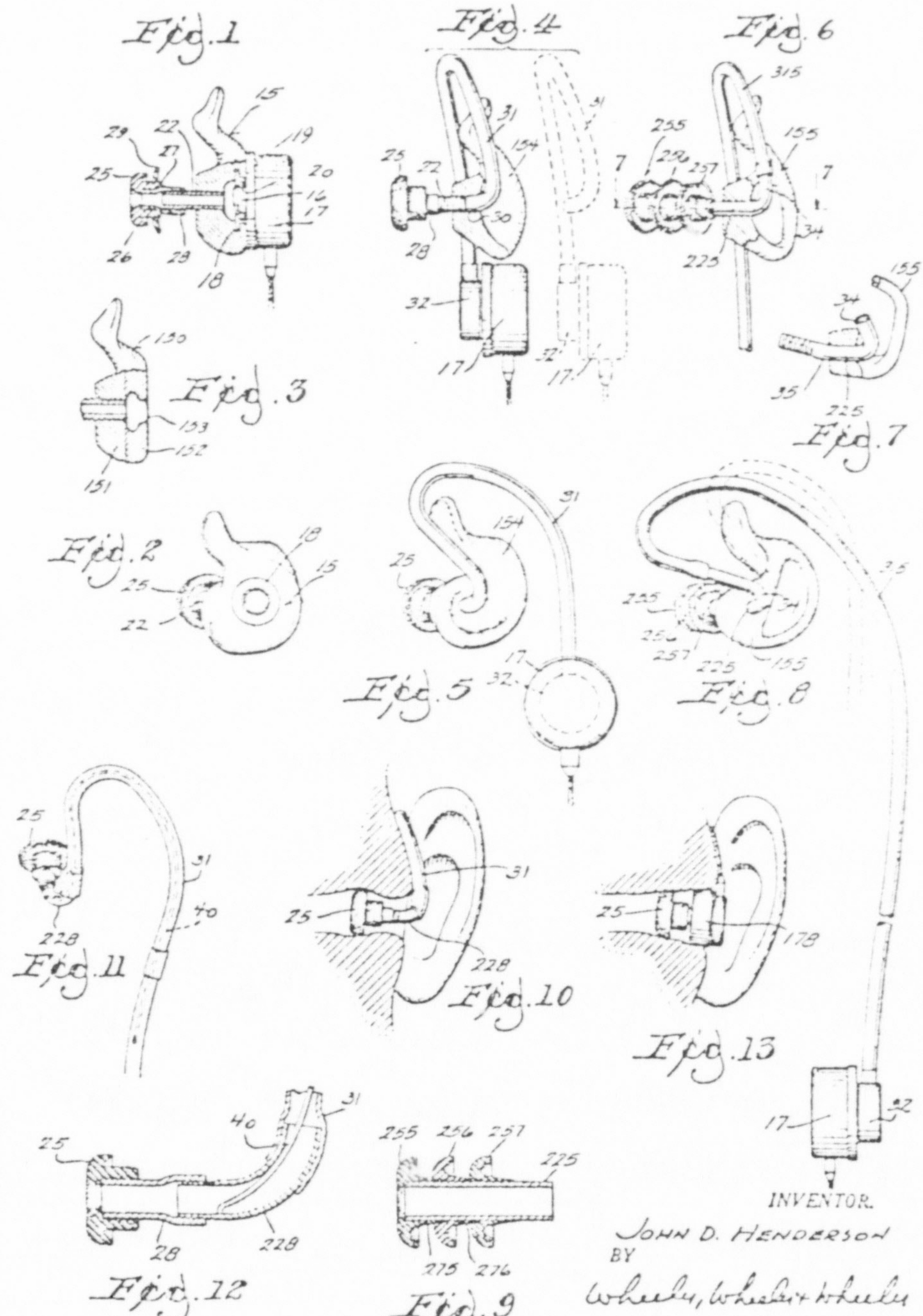
June 7, 1960 J. D. HENDERSON 2,939,923

HEARING AID PLASTIC EAR PIECES

Filed Aug. 3, 1955



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United States Patent Office

2,939,923

Patented June 7, 1960

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2,939,923

HEARING AID PLASTIC EAR PIECES

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Filed Aug. 3, 1955, Ser. No. 526,126

5 Claims. (Cl. 179—182)

This invention relates to hearing aid plastic ear pieces.

The major feature of the invention consists in the provision of a very soft tip for insertion into the auditory canal. The tip is desirably mushroom shaped with a radially projecting flange or head and it desirably comprises synthetic sponge whereby it is not only exceptionally soft but is somewhat porous. Such a tip is not only much more comfortable than any heretofore known but it may be used coincidentally with medication because its porosity enables it to retain the medication while the hearing aid is being worn instead of excluding the medication from contact with the skin of the auditory canal.

The degree of softness of the tip is such that it could not be introduced into the auditory canal were it not mounted upon an inner plastic tube desirably vulcanized to the tip and which, while resiliently flexible, is yet sufficiently rigid to be used as a means of propelling the tip into position. I may also provide the shank of my improved synthetic sponge tip with a secondary head (or heads) which may be of increased diameter as compared with the first head, the first head serving to anchor the shank within the second head against accidental withdrawal.

Another feature of the invention consists in the manner in which the parts of the tip are connected to each other and to a molded insert which is desirably used as a means of anchoring it in the concha of the outer ear, the receiver being alternatively mounted directly on this insert or at the end of a tube leading to the insert and thence to the tip first described above. In certain cases I connect the receiver directly with the tip, the receiver in such cases being small enough to fit into the end or interior of the auditory canal.

Where the concha fitting is dispensed with, I may use another means of anchoring the external tubing about the wearer's ear, including a piece of deformable spring wire shaped to fit over the ear and disposed within the sound tube.

In the drawings:

Fig. 1 is a view partially in side elevation and partially in section showing a hearing aid ear piece made in accordance with a preferred embodiment of this invention.

Fig. 2 is an end elevation of the device of Fig. 1 with the receiver omitted.

Fig. 3 is a view similar to Fig. 1 illustrating a modified embodiment of the concha insert.

Fig. 4 is a view partially in side elevation and partially in section showing a modification of the device of Fig. 1, the speaker being at the end of a sound tube encircling the wearer's ear.

Fig. 5 is a view in perspective of the device of Fig. 4.

Fig. 6 is a view partially in perspective and partially in section showing a further modification of the device of Fig. 4.

Fig. 7 is a fragmentary detail view taken in section on the line 7—7 of Fig. 6.

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Fig. 8 is a view in perspective showing the device of Fig. 6.

Fig. 9 is an enlarged detail view in axial section of the auditory canal insert used in the device of Figs. 6 and 8.

Fig. 10 is a view partially in side elevation showing a further modified embodiment of the invention, portions of the auditory canal being shown in section.

Fig. 11 is a view in perspective of the device of Fig. 10.

Fig. 12 is an enlarged detail view in axial section of an end portion of the device shown in Figs. 10 and 11.

Fig. 13 is a detail view in side elevation of a further modified embodiment of the invention, portions of the auditory canal being illustrated in section.

It is conventional practice to provide numerous forms and sizes of the concha-insert generically designated herein by reference character **15**. My insert **15** differs from conventional practice in that, in the first place, it is desirably made of reasonably flexible plastic. Instead of being hard, it is relatively easily deformable so that it readily adapts itself to the wearer's ear notwithstanding that the latter may deviate from the various standards which have been set up in the industry.

In the second place, my improved insert **15** is desirably made as shown in Figs. 1, 2 and 3 for the detachable reception and retention of the sound discharge sleeve **16** of the electrical speaker **17**. In the construction shown in Fig. 1 and Fig. 2, a hard insert **18** flanged for permanent retention in the plastic mold **15** has been molded into the plastic. It has an under-cut groove at **19** to receive a snap ring which releasably engages the shallow groove **20** in the sound discharge sleeve **16** of the speaker **17**.

Instead of providing the plastic element **15** with a metal insert **18**, I may make the element **15** of two types of plastic fused together as shown in Fig. 3 at **150**. The over-all shape remaining the same, there is a base component **151** having a high degree of resilient flexibility and a relatively much more rigid component **152** which, while retaining sufficient flexibility to receive the enlarged end of sleeve **16**, still has rigidity enough to prevent the escape of such head from its constricted mouth at **153** through accident. The devices of Figs. 3 and 1 are both adapted to receive and detachably support the speaker unit **17** upon the concha element or retainer **15**.

A short length of relatively rigid but somewhat flexible tubing **22** which is externally screw threaded is screwed or molded into the fitting **15** and projects therefrom in a direction to enter the auditory canal and to receive sound waves issuing from the output sleeve **16** of speaker **17**. The tip generically designated by reference character **25** is molded of very soft synthetic sponge in the preferred embodiment of the invention, its head portion **26** being soft enough to adapt itself not only to a wide variation of diameters of auditory canals of different wearers but to conform to the various shapes which such canals may assume in cross section. The synthetic sponge may be rubber but is desirably a spongy plastic (synthetic resin).

The shank portion **27** of the tip **25** is joined by fusion or vulcanization or by adhesive integrally with a plastic tube **28**, the outer end of which is forced over the screw threaded tube **22** and is threaded thereon to any desired extent of telescopic lap. The element not only provides a secure mounting of the tip on tube **22** but also permits a very substantial range of axial adjustment to adapt the device to the requirements of different wearers. The sleeve **28**, like the tube **22**, is relatively considerably stiffer than the synthetic sponge tip **25**, since otherwise the

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tip could not be forced into place within the user's auditory canal.

Optionally I may provide an additional annular flange 29 seated on the tubular shank 27 of tip 25 and likewise made of very light soft synthetic sponge. The auxiliary flange or head 29 will usually be of increased diameter. It provides an easy and satisfactory way of adapting the tip to the auditory canal of a person whose canal is bigger than that for which the dimensions of tip 25 were designed. The head 26 of the tip 25 prevents relative displacement of tip 25 with respect to the auxiliary head 29 in the direction of withdrawal. It is thus impossible for the auxiliary head 29 to become lost within the auditory canal of the wearer, since withdrawal of the hearing aid will necessarily take the auxiliary head 29 with it.

As stated above, the fact that the head 25 and the auxiliary head 29 are made of soft porous spongy material not only makes the respective heads easily conformable to the patient's ear canal contours, but enables the tips to be used as applicators for the medicinal treatment of the skin surfaces of the canal. In the use of ordinary hearing aids, the surfaces engaged by the plug or insert are inaccessible to medicaments and can not be treated while the hearing aid is being worn.

In the device shown in Figs. 4 and 5, the plug or insert 25 may be identical with that shown in Fig. 1. The threaded tube 22 does not extend as far into the concha element 154, leaving a socket at 30 into which the end of flexible tube 31 is inserted to carry sound over the wearer's ear from the connector 32 of receiver 17. Since the receiver is remote from the concha fitting 154 the latter is shaped differently and has no means for receiver connection such as that shown in Figs. 1–3. As shown in dotted lines, it is readily possible to disconnect the speaker and the speaker tube 31 by withdrawing the end of the latter from the fitting 154.

Figs. 6–9 show a somewhat differently shaped concha fitting 155 and the tube 225, instead of stopping at the fitting as in Figs. 1 and 4, is carried through to the outside of the fitting and turned upwardly at 34 to receive a telescopic sleeved connection with the free end of the speaker tube 315. This tube, instead of being short, to position the speaker behind the ear, as in the device of Figs. 4 and 5, is long enough to locate the speaker within the wearer's shirt or elsewhere.

The tube 225 which projects into the auditory canal from the concha fitting 155 is also somewhat elongated and carries a multiple sponge material head. The outer head 255 corresponds closely to that shown in Figs. 1–5 but desirably has a tapered shank at 275 onto which the second head 256 is forced. This in turn has a tapered shank 276 onto which the third head 257 is forced. Any desired length of tube 225 may be used and any desired number of soft heads 255, 256 and 257 may be mounted thereon.

It will be observed that the device is adjustable to extend the tube 315 from the elbow 34 at any desired angle and to any desired length. Fig. 7 shows the elbow rotated to a different angle from that shown in Fig. 6 and it also shows the threaded inner end of tube 225 bent at 35. Larger or smaller ears are accommodated by simply adjusting the tube 315 over the wearer's ear and cutting off any surplus from its free end before the latter is sleeved over the elbow 34.

Figs. 10 to 13 show the concha fitting eliminated altogether. The synthetic sponge insert 25 shown in Figs. 10 and 13 is identical with that shown in Figs. 1-5. The flexible but less yieldable tube 228 has direct connection either with the sound tube 31 shown in Fig. 10 or with a small diametered speaker 178, fitting within the auditory canal as shown in Fig. 13.

Where the construction of Fig. 10 is used, it may optionally be desired to provide some means other than the concha insert to hold the equipment in place on the wearer's ear. For this purpose I may use within the sound tube 31 a piece of wire as indicated at 40. The wire is sufficiently flexible so that it can be manipulated to a desired form and it is sufficiently resilient to return to that form after any normal deformation involved in applying or removing the hearing aid. The internal wire will, therefore, hold the sound tube 31 in a position which will conform it closely to the contour of the wearer's ear at the junction of the ear to the head, thus serving as a means of holding the plug in its proper place in the auditory canal.

I claim:

1. A hearing air ear plug comprising a sponge tip mounted on a separately fabricated tube, the tip and tube being of different materials having different degrees of flexibility and unitarily connected, the tip being so soft and easily deformable that it cannot readily be inserted within the ear canal without support, the tube opening through the tip and being of a material sufficiently flexible to accommodate itself readily to changes in direction of the ear canal but sufficiently stiff to support, guide and propel the tip during insertion, and to maintain an opening through the tip when in use.

2. The device of claim 1 in which said tip is mushroom shaped, having a tubular shank portion sleeved on the tubular support, and at least one flaring peripheral flange.

3. The device of claim 1 in further combination with a sound tube communicating with the tube first mentioned and having a free internal longitudinally extending wire yieldably defining the direction of the sound tube.

4. The device of claim 1 in which the tip has a shank portion telescopically lapping the tube to an adjustably predeterminable extent, whereby to position the tip at a predetermined point in the ear canal, the tube having means for locating its position respecting the outer ear.

5. In a hearing aid the combination with a tubular support sufficiently flexible to accommodate itself to the external ear canal, of a first head integrally comprising a tubular shank portion and a peripheral flange of highly flexible soft sponge material, said tubular shank portion being telescopically positioned on said support, and a second head of flexible soft sponge material mounted on the support and integrally comprising a tubular shank portion and peripheral flange, the second head having its shank portion sleeved on the shank portion of the first head and encircling the support.

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PLAINTIFF'S EXHIBIT
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Aug. 7, 1934. J. B. KELLY 1,969,559

ACOUSTIC DEVICE

Filed June 16, 1933

FIG. 1

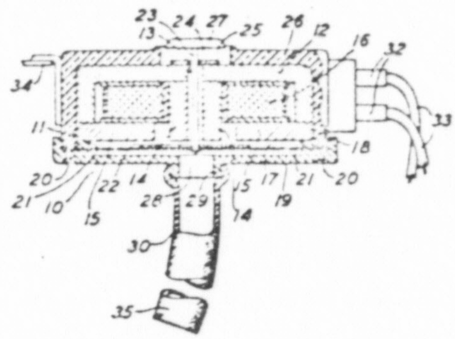


FIG. 2

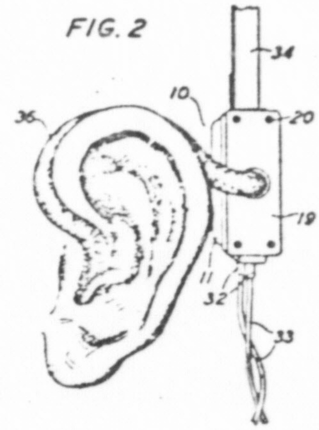


FIG. 3

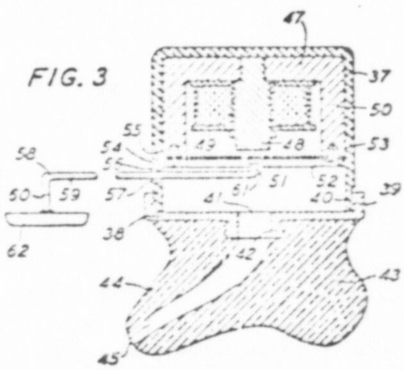


FIG. 4

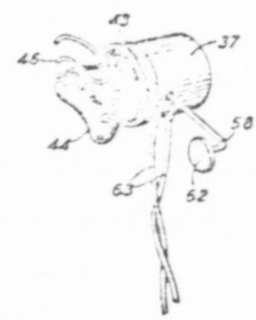
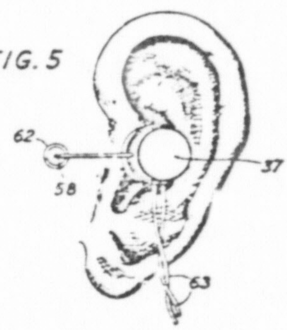


FIG. 5



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Ex. 45 206

Patented Aug. 7, 1934 1,969,559

UNITED STATES PATENT OFFICE

1,969,559

ACOUSTIC DEVICE

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Application June 16, 1933, Serial No. 676,104

10 Claims. (Cl. 181—23)

This invention relates to acoustic devices and more particularly to devices for aiding or improving the reception and detection of sound wave vibrations by those who are hard of hearing.

An object of this invention is to enable the hard of hearing to receive and detect sound waves more readily and more naturally over a greater portion of the frequency range of speech and music.

A feature of this invention comprises a telephone receiver having a vibratory member adapted to actuate a bone vibrating or agitating member, and, also, to generate sound waves, which waves are led through a restricted path or passage to the ear drum of a user.

Another feature comprises a telephone receiver supported in the ear of a user, the vibratory member of the receiver being adapted to generate sound waves which are led directly to the user's ear and also to actuate a vibrator member adapted to contact with the skin and to vibrate the head bone in front of the user's ear.

One embodiment of this invention comprises a telephone receiver comprising a case enclosing a vibratory member and actuating means therefor, a vibrator member connected to the vibratory member at one end and adapted to be pressed against and to vibrate the head bone behind a user's ear, and a sound wave conduit or tube defining a restricted passage and leading from the interior of the case and adapted to be inserted in the ear canal of a user. The receiver may be supported on the user's head by a headband, strap or ribbon.

Another embodiment comprises a telephone receiver comprising a case enclosing a vibratory member and actuating means therefor, the receiver being coupled to a hard or soft rubber molded member adapted to be inserted in the user's ear to support the receiver therein, and having a sound wave passage leading from the vibratory member to the user's eardrum, and a vibrator member extending from the case, vibratable by the receiver vibratory member, and adapted to rest against the user's skin and to vibrate the head bone in front of the ear.

A more complete understanding of this invention will be derived from the detailed description which follows, read with reference to the appended drawing, wherein:

Fig. 1 is a side elevational view of one embodiment of this invention, partly broken away and partly in section to expose the details of its construction;

Fig. 2 illustrates the mode of use of the device of Fig. 1, and the manner in which it is associated with the user's ear and head (not shown);

Fig. 3 is a sectional view of another embodiment of this invention;

Fig. 4 is a view in perspective of the device of Fig. 3; and

Fig. 5 illustrates the mode of use of the device of Fig. 3, and the manner in which it is associated with the user's ear and head (not shown).

There is shown in Figs. 1 and 2 an acoustic device comprising a telephone receiver, designated generally 10, having a casing or housing 11, elongated and substantially rectangular in shape, and preferably of insulating material. Within the casing is an electromagnet structure comprising a U shaped bar or member 12 of magnetic material having a central perforation or drilling 13; spaced, central pole pieces or extensions 14, 14; radially extending pole pieces 15, 15; and an energizing coil 16 disposed within the magnet structure and surrounding the central pole pieces. A diaphragm 17, substantially rectangular in shape and either of magnetic or non-magnetic material, is mounted in the open end of the casing and is secured to the rim 18 along its short edges by the casing cover or closure member 19 and suitable fastening means such as screws 20. The width of the diaphragm is less than the width of the inside of the casing so that the long edges of the diaphragm are free and unclamped. Spacer strips or members 21 restrain movement of the electromagnet with reference to the diaphragm. An armature 22 is secured to the central portion of the diaphragm in spaced relation to the extremities of the pole pieces 14, 15. An elongated member or rod 23 is attached to the center of the diaphragm, extends between the pole pieces 14, 14, through the drilling 13 and an aligned opening in the lateral movement limiting plate 24, and through an opening 25 in the wall 26 of the casing, to terminate in an enlargement or button member 27 which is positioned slightly above the plane of the outer surface of the wall 26 of the casing. The cover member 19 contains an opening or aperture 28 surrounded by a flange portion 29 over which is drawn one end of a sound wave conduit or tube 30. The energizing coil is connected to terminals, (not shown), with which the cord tips 32, 32 of the receiver conductors 33, 33 engage.

The receiver is supported on the head of the user behind his ear preferably by a band or strap 34 of spring metal, such as steel, so that the button 27 makes firm contact with the skin of the head over the mastoid eminence. The free

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end 35 of the tube is inserted in the ear. While it is preferable that the free end be of a soft or flexible material, the remaining portion 36 may be stiff, rigid, or of fixed shape and of the contour shown in Fig. 2, so as to be the more readily retained between the user's head and the lobe of the ear and rendered comparatively inconspicuous.

In operation, the vibrations of the diaphragm cause vibration of the rod 23 and button 27 to agitate and vibrate the mastoid eminence, and, simultaneously, the sound waves generated by the diaphragm are led through the restricted path or passage provided by the tube 30 directly to the eardrum. In this way, the user derives the benefit of both bone and air conduction of the sound wave impulses.

The acoustic device of Figs. 3, 4 and 5 comprises a casing or housing 37, substantially cylindrical in shape and having an open end normally closed by a cover or closure member 38 having an interiorly threaded flange portion 39 engaging the externally threaded portion 40 of the casing. The cover contains a central opening or aperture 41, and has an annular extension 42. An insert member or earpiece 43, preferably of hard or soft molded rubber and adapted to be inserted in the user's ear, is secured to the cover, having a recessed portion into which the extension 42 is adapted to fit tightly. This ear insert substantially fills the cavum conchae of the ear, and the portion 44 is shaped to firmly seat into the ear and tightly engage in the auditory canal so as to form a substantially sound tight connection. The constricted passage or path 45 in the insert member connects the interior of the casing with the user's ear canal. The wire or spring 46 is sufficiently flexible to be adjustable in shape to fit the contour of the cymba conchae of a particular user, and aids in holding the receiver securely in the ear. The casing houses a pot-shaped member 47 of magnetic material having a center pole portion 48 surrounded by an energizing coil 49, and an outer pole portion 50 to which a diaphragm 51 of magnetic material is secured at its periphery by suitable fastening means, such as clamping ring 52 and screws 53. The diaphragm has an angularly extending tab portion 54, adapted to seat in a recess 55 in the inner surface of the casing and having an aperture 56 in alignment with the aperture 57 in the cylindrical wall of the casing.

Attached to the central portion of the diaphragm is a rod or elongated member 58 having a straight portion 59 and parallel portions 60 and 61 at the ends of the straight portion and angularly disposed with reference thereto. The portion 59 extends through the apertures 56 and 57, and when the diaphragm is vibrating, the tab 54 provides a support on which it pivots. The portion 60 terminates in an enlargement or button 62 adapted, when the receiver is mounted in the ear of a user as shown in Fig. 5, to press firmly against the skin in front of the ear in region of the temporal bone. Electric signal impulses are led to the receiver through the conductors 63.

In operation, the vibration of the diaphragm in accordance with sound wave impulses received by the receiver, generates sound waves which are led directly to the user's eardrum through the aperture 41 and passage 45, and vibrates the connecting rod 58 and button 62 wherby the temporal bone is agitated or vibrated. The user is enabled, therefore, to detect or receive sound wave impulses by bone and air conduction, simultaneously.

While the features of this invention have been disclosed in several specific embodiments, it is understood, of course, that various modifications may be made in the details of construction thereof without departing from the spirit of this invention as defined in the appended claims.

What is claimed is:

1. An acoustic device comprising a vibratory member, means for actuating said member, a case containing said member and means, means providing a restricted sound wave passage leading from said vibratory member to the eardrum of a user, and a vibration conducting rod attached at one end to the vibratory member and having an enlarged button-shaped portion at its other end, said enlarged portion adapted to rest against the skin of the user and to vibrate the head bone of the user in the region of the ear.

2. An acoustic device comprising a vibratory member, means for actuating said member, a case containing said member and means, said case comprising a wall on each side of said vibratory member, each wall having an aperture therein, a hollow tubular member providing a continuation of the aperture in one of said walls and a path for sound waves leading to the eardrum of a user and a vibrator member attached to said vibratory member and having a button member positioned in the aperture in the other of the walls of said case and adapted to rest against the skin and to vibrate the head bone of the user in the region of the ear.

3. An acoustic device comprising a vibratory member, means for actuating said member, a case containing said member and actuating means, means actuated by said vibratory member for communicating the movement thereof to the head bone in back of a user's ear, said last mentioned means consisting of a rod-like member having a button member at one end for engagement with the user's head, and a tubular member connecting the interior of the case and the user's eardrum to communicate to the latter the sound waves generated by said vibratory member.

4. An acoustic device to be mounted on a user's head behind the user's ear, comprising a vibratory member, means for actuating said member for the generation of sound waves, a casing for said member and actuating means, and means connecting the interior of said casing with the ear canal of the user to conduct the generated sound waves thereto, said means comprising a hollow tubular member, one end of which is insertable in the ear of a user, the other end of which is connected to said casing, and the intermediate portion of which follows the contour of the head between the latter and the ear lobe.

5. An acoustic device comprising a vibratory member, means for actuating said member, a member insertable in the ear of a user of the device, said insertable member having a central sound wave passage, a case containing the vibratory member and actuating means and attached to and supported by said insert, and a vibrator member consisting of a rod-like member connected at one end to the vibratory member and having a button member at its other end to rest against the skin of and to vibrate the head bone in front of the user's ear.

6. An acoustic device to be mounted in a user's ear, comprising a vibratory member, means for causing said member to vibrate, a casing for said member and means, and means for applying the

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vibrations of the vibratory member to the head bone of the user in the region of the ear, said head bone vibrating means consisting of a rod-like member attached to said vibratory member and having a button member at its other end for engaging the head.

7. An acoustic device to be mounted in a user's ear, comprising a vibratory member, means for causing said member to vibrate, a casing for said member and means, and means attached to said vibratory member for applying the vibrations thereof to the head bone of the user in the region of the ear, said means comprising an elongated member attached at one end to the vibratory member and having its other end adapted to be placed against the skin of the head, said elongated member being pivotally supported at a point intermediate its ends.

8. An acoustic device comprising a vibratory member, means for actuating said member, a member insertable in the ear of a user of the device, a case containing the vibratory member and actuating means and attached to and supported by said insert, said insertable member having a sound wave passage connecting the interior of said case with the user's ear canal, and a vibrator member connected to the vibrating member and extending from said case to rest against the skin of and to vibrate the head bone in front of the user's ear, said means being pivotally supported at a point intermediate its ends.

9. An acoustic device comprising a casing, a vibratory member and actuating means therefor in said casing, said casing having a pair of substantially parallel walls, each having an aperture therein and disposed on opposite sides of the vibratory member, means connected to one of said walls connecting the interior of the casing through the wall aperture with the ear drum of the user, and a vibrator rod secured at one end to the diaphragm and terminating in a button member in the aperture in the other of said walls, said button member engaging the user's head when the device is supported behind the user's ear with the said other apertured wall adjacent thereto.

10. A bone conduction receiver comprising a vibratory member, means for actuating said member, and a vibration conducting rod attached at one end to said vibratory member and having an enlarged end portion at its other end for engagement with the user's body in the region of the ear, said rod being pivotally supported intermediate its ends.

JOSEPH B. KELLY.

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PLAINTIFF'S EXHIBIT 46

THE POST OFFICE ELECTRICAL ENGINEERS' JOURNAL

THE INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

Ex. 46 210

A Light-weight Headset for Telephone Operators

H. J. C. SPENCER, A.M.I.E.E., and J. S. P. ROBERTON, B.Sc.(Eng.)†

U.D.C. 621.395.623.64:621.395.722

A new headset for telephone operators has been developed which not only has a superior performance to the head-and-breast set, but is considerably lighter and more comfortable to wear. Unlike the head-and-breast set, the new instrument does not suffer from the disadvantage that the transmitter mouthpiece cannot follow the wearer's mouth as the head turns. This improvement results from the transmitter being mounted next to the receiver in a common housing worn on the ear, a light horn being used to feed speech from the mouth to the transmitter.

INTRODUCTION

FOR very many years the head-and-breast-set type of operators' telephone has been used in the Post Office. Instruments of this type suffer from the fundamental disadvantage that the mouthpiece of the transmitter does not follow the wearer's mouth as the head turns. As a result, unless the wearer makes a conscious effort always to speak into the mouthpiece, sending efficiency may be seriously degraded. This is illustrated by the curves of Fig. 1, which show how the output decreases as the distance of the mouthpiece from the user's mouth increases. In addition, head-and-

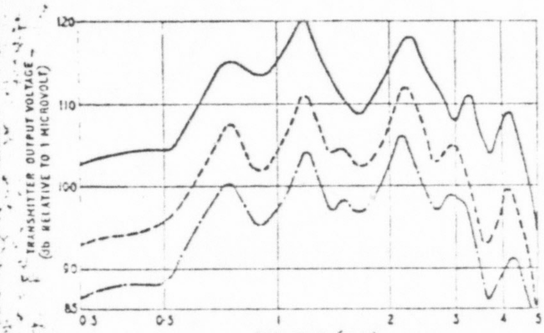

FIG. 1.—BREAST-SET TRANSMITTER—VARIATION OF OUTPUT WITH DISTANCE FROM MOUTH

breast sets are unpopular with operators because they are cumbersome to wear. The particular set used by the Post Office has the further disadvantages of being rather heavy and of having a poor transmission performance compared with that of the new type of table telephone.[1] This poor transmission performance is no disadvantage for public exchange use, because of the operator's favourable position in the line network, but it would present problems if the headset were used at private branch exchanges (P.B.X.s) working on the recently extended transmission limits for local line networks.[2] Because of these disadvantages the Post Office has now developed, in co-operation with the telephone manufacturers, a light-weight one-piece headset to supersede the head-and-breast set, and the process of completely replacing the old instruments by the new has commenced. The new instrument is illustrated in Fig. 2.

THE NEW HEADSET

As a preliminary to work on a new design, user trials were made of a one-piece instrument for which the now conventional practice was followed of putting the transmitter at the end of a boom projecting from the receiver (a practice pioneered in this country in 1933 by Standard Telephones and Cables, Ltd.). The trials showed that the concentration of transmitter weight at the end of the boom resulted in an unstable arrangement, and for the new headset an alternative solution has been adopted: namely, to mount the transmitter next to the receiver in a common moulded housing worn on the ear. Speech is fed to the transmitter from the mouth by a light horn. The advantages of this novel form of construction compared with the use of a transmitter supported on a boom are:

(*a*) A better balance is achieved, giving increased stability with lower headband pressure.

(*b*) Operators naturally like the obstacle in front of

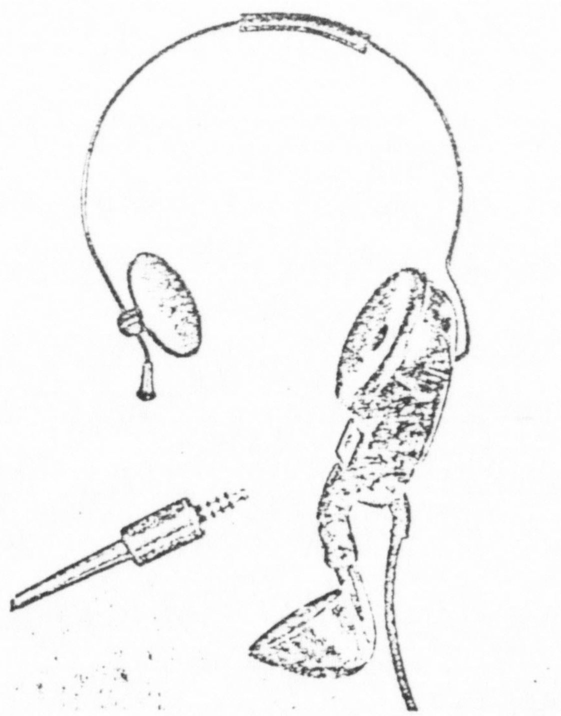

FIG. 2—THE NEW HEADSET

† Mr. Spencer is in the Subscribers' Apparatus and Miscellaneous Services Branch, E.-in-C.'s Office, and Mr. Roberton is with Standard Telephones & Cables, Ltd.

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the lips to be as small as possible. For a given size of obstacle greater sending efficiency is obtained because the whole mouth area of a horn is fully effective, whereas, because its edge is clamped, only part of the area of a transmitter diaphragm is completely effective.

(*c*) A horn has a slight directional effect which increases with frequency, and this gives some discrimination against undesirable ambient noise.

(*d*) Cord arrangements are simplified. A 4-way cord enters the set through a single hole and is connected directly to the transmitter and receiver. There is no need for a separate cord to the transmitter; such a cord would involve additional series connexions and could get tangled with other parts of the set.

(*e*) The transmitter is much less vulnerable to mechanical damage.

(*f*) The arrangement is more hygienic because the horn can easily be removed and cleaned. It can also be immersed in disinfectant, which would not be possible with a complete transmitter.

(*g*) The overall design of the set is cleaner, giving fewer awkward traps for hair, and adjustment to suit the head of the wearer can be made naturally while the set is on the head.

The new headset is designed to combine lightness with strength and resilience so that it can withstand mechanical shocks in service. This combination is achieved largely by the use of nylon and other resilient plastics for the mouldings. Nylon has quite a good surface finish, and its toughness and shock resistance give almost unbreakable mouldings. The strength of nylon has allowed thin sections to be used to reduce weight. The total weight of the headset, less plug and cord, is under 5 ounces, which is less than the weight of the receiver alone of the earlier instrument and less than one third of the weight of the complete head-and-breast set. An important feature which contributes to the shock resistance of the headset is the provision of a springy joint at the "elbow" that joins the horn to the body of the set. This joint is often a region of weakness in headsets with transmitters supported on a boom. In addition, the use of flexible plastic gaskets at the joints of the various parts of the acoustic system and the provision of springs for holding the transmitter and receiver capsules in place both contribute to the shock resistance.

Apart from its toughness, nylon is a very suitable material because of the absence of harmful effects to the skin through contact with it; it is, in fact, frequently used in surgery for inclusion within the human body.

A small but useful detail in the body moulding is a frame in which an identifying label may be fixed.

Transmitter and Associated Acoustic System

The transmitter is a miniature carbon-granule sealed capsule designed specifically for use in the headset. It is illustrated in section in Fig. 3. The electrodes of the transmitter are parts of concentric spheres; this shape, combined with a very small carbon charge, makes the transmitter sensitive and reasonably free of amplitude distortion, as may be seen from Fig. 4, which shows sensitivity/frequency curves for three different sound pressures. The electrodes are made from brass plated with gold; the front electrode is fixed to the light alloy diaphragm and the parts are assembled in a die-cast aluminium frame. The charge of carbon granules is

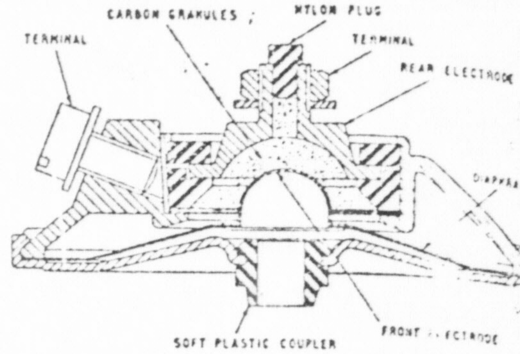

FIG. 3—CROSS-SECTION OF TRANSMITTER

inserted through a hole in the rear electrode terminal, which is then closed with a tight-fitting nylon plug. As the transmitter is designed to be pressure-operated in conjunction with the horn of the headset, the volume of air in front of the diaphragm is reduced by the front cover of the transmitter being designed so that it follows closely the diaphragm contour. The transmitter is sealed to the acoustic tube in the headset by a soft p.v.c. coupler, which is captive in the transmitter front cover.

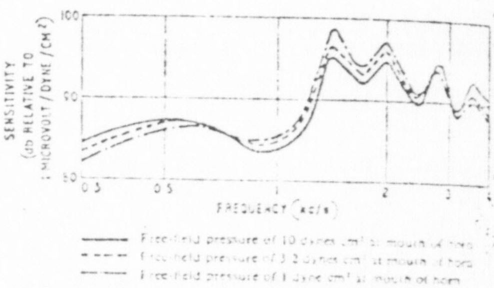

FIG. 4—VARIATION IN SENSITIVITY WITH SOUND LEVEL

The acoustic system consists of the parts shown in Fig. 5. It is designed to allow the horn to take up alternative positions so that the headset may be worn on either ear, and there is a cone of free movement of the horn about each position to cater for variations in head shapes. The parts are assembled with the helical spring passing through them and in tension between a die-cast anchor at the set end and a washer at the horn end. This keeps the joints of the system in compression, so giving good sealing. Sealing at the joints is assisted by resilient polythene washers, the washer between the ball and elbow being conical in shape. The sealing is also improved by care in moulding to obtain close fitting surfaces between the elbow and the headset body. The tension of the spring also ensures a secure connexion between the horn and the headset.

The horn is exponential in shape, i.e. its cross-sectional area at a point distance x cm from the throat is related to the area at the throat by the equation

$$S_x = S_0 \exp mx$$

S_0 and S_x are the areas (cm²) at the throat and at x, respectively, and m (per cm) is known as the flaring constant.

The action of the horn can be likened to that of an

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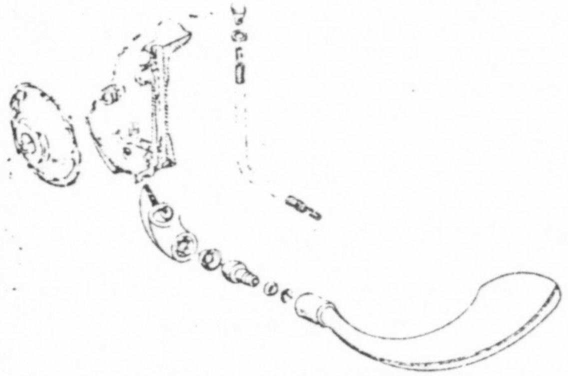

FIG. 5—THE ACOUSTIC SYSTEM

electrical transformer; large air movements with low pressures at the mouth of the horn are converted to small air movements with high pressures at the throat. The small air movements make it unnecessary to have an acoustic channel with a large cross-section, but the high pressures do require the sealing of the channel to be good. Exponential horns have the property of transmitting sound waves efficiently down to a frequency determined by their dimensions. Below this frequency, given by the equation $f_{co}=(mc)/(4\pi)$ where c is the velocity of air in cm/sec and m is the flaring constant already referred to, the horn transmits the sound waves with progressively greater loss, thus acting as a high-pass filter. This property has been used in the headset to equalize to some extent the frequency response of the transmitter. The carbon-granule transmitter has one main resonance, just below 1,200 c/s, controlled largely by the mass and stiffness of the diaphragm and front electrode. If used alone the transmitter would have a peaked response. The horn dimensions have, however, been chosen so that the cut-off frequency is just above the peak of the response of the transmitter alone. This peak is therefore reduced, and the response of the combination is maintained reasonably constant up to a frequency of 4,000 c/s.

A subsidiary function of the helical spring in the acoustic channel is to reduce peaks and troughs in the transmission characteristics of the horn. These occur because the horn is of finite length and is not matched acoustically to free air, so that reflections take place from the open end. These emphasize some frequencies and attenuate others. The presence of the spring more than doubles the surface area within the channel and the consequent acoustic damping reduces the difference between peaks and troughs from 12 db to 5 db, which is tolerable. Below its cut-off frequency the horn behaves as a sound conduit having a rather high acoustic mass. This mass resonates with the acoustic stiffness of the volume of air between the inside of the front of the transmitter and the diaphragm at a frequency of about 500 c/s. This resonant peak is also adequately damped by the presence of the spring in the acoustic channel.

Receiver

The receiver is a miniature version of the rocking-armature receiver,[3] and has been developed specially for the headset. The magnetic drive-unit of the new receiver is identical with that in the larger one, but size and weight have been reduced by using a smaller diaphragm and by omission from the receiver capsule of some of the acoustic equalization structure. Retention of the same magnetic unit has made it necessary to drive the smaller diaphragm off-centre: this has had the beneficial effect of increasing the effective portion of its area so that the loss in efficiency caused by the reduction in size is less than it would otherwise be. The acoustic equalizing-volume and the outlet holes are omitted from the receiver capsule and are formed instead in the moulded earpiece, to which the capsule is sealed by a resilient rubber ring.

A housing for the receiver only of the headset is available. Two receivers may be joined by a common head-band to form a double-receiver headgear, and there is also a version of the headset which has a second receiver. By the use of appropriate cords a pair of receivers may be coupled in series or in parallel, or they may be connected to separate circuits. A range of receivers having different impedances is available.

Headband

After trials of a number of different designs, the double-pad headband, shown in Fig. 2, was found to give the greatest comfort and stability, being based on support at three points, the earpiece, the top head-pad and the side head-pad. The pads are made from a soft lead-free grade of p.v.c. Since each is a tight sliding-fit on the headband wire, the pads may be adjusted to the best position for comfort and balance for each wearer. The hard-drawn steel wire is covered with shrunk-on p.v.c. sleeving and may be bent slightly to suit the needs of individual wearers. Soldered to the instrument end of the wire is a phosphor-bronze ball which is gripped in a spring-loaded socket in the headset cover. This ball-joint, while allowing easy adjustment of the angle of the wire to the set, is stiff enough to add stability while the headset is being worn. The free end of the headband wire is guarded with a screw-on nylon ferrule.

Plugs and Cords

To match the light weight of the new headset the Post Office has adopted a new miniature 4-way plug. The plug follows the general form of its predecessor, but improvements in detail and the use of nylon for the moulding material result in its being much more robust and reliable in spite of its reduced size.

The cords used for the new headset have p.v.c. insulation with a nylon outer braiding and are round in cross-section. Particular attention has been paid to relieving the cord terminations of strain. At the plug end of the cord the strains are taken by a long protective sleeve which is too large to pull through the hole in the plug cover. At the headset end, the strains are taken by a grommet moulded on the cord. The grommet is curved to let the cord fall away from the set naturally and is square in cross-section, where it engages the headset, to prevent twisting.

PERFORMANCE

Sending Efficiency

The output/frequency characteristics of the new headset and the old breast-set transmitters are shown in Fig 6. The output of the headset is shown for a feeding current of 40 mA, while the breast-set transmitter output is shown for 120 mA, this being its normal operating condition. It will be seen that, even at the much lower current, the new headset has an output equal to that of the breast set. Where the

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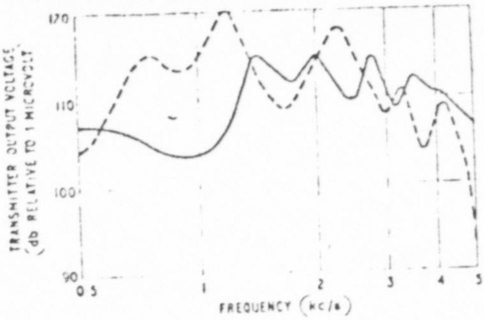
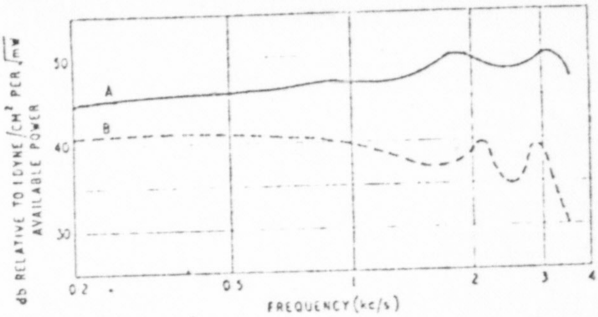


New headset (40 mA transmitter current)
Breast set (100 mA transmitter current)

Speaking distance 1 in.; free-field sound pressure 1 dyne/cm² at 1 in. from mouth

FIG. 6—TRANSMITTER OUTPUT/FREQUENCY CHARACTERISTIC



A Receiver of new headset
B Receiver of old-type set

FIG. 7—RECEIVER SENSITIVITY/FREQUENCY CHARACTERISTIC

maximum performance is not required, therefore, it is possible to reduce the feed-current below 120 mA. This has a number of advantages:

(*a*) The life of the transmitter is increased (at 120 mA the life of the new transmitter is equal to that of the transmitter in the breast set).

(*b*) The heat dissipated in the transmitter is reduced. Because the transmitter is carried on the head any heat from the transmitter might be noticeable, but the effect is negligible at 40 mA.

(*c*) Power requirements are reduced. There are some subscribers' installations in which the major power requirement is for the operators' transmitters. Worthwhile economics can be realized at such installations.

Receiving Efficiency

The sensitivity/frequency characteristics of the receiver in the new headset and the receiver in the head-and-breast set are given in Fig. 7. They show that the new receiver is approximately 7 db more sensitive than the old and has a superior frequency response. The new receiver shares with the larger rocking-armature receiver the advantage that its acoustic output-impedance is low, so that reduction in sound pressure at the ear by leakage between ear and earpiece is minimized.

INTRODUCTORY PROBLEMS

It has not been possible to use the new headset as a direct replacement for the old, firstly because of the smaller plug used with it, and secondly because in the majority of Post Office applications its superior performance is actually an embarrassment. The following changes, made to the operator's position circuit at sleeve-control exchanges, are typical of those made when the headsets are introduced:

(*a*) All jacks are changed to suit the new plugs.

(*b*) An additional 820-ohm resistor is inserted in the d.c. feed to the transmitter. This reduces the current to about 40 mA, at which the sending efficiency is the optimum for this application.

(*c*) A 150-ohm resistor is fitted within the headset, shunting the receiver and reducing receiving efficiency by about 4 db.

It was necessary to connect the receiver shunt within the headset, rather than in the switchboard, because for an interim period the old-type handsets with 2P receivers will continue to be used on the same switchboard positions and with this type of telephone the shunt would cause a reduction of receiving efficiency which would not be tolerable. The handset transmitter is sufficiently sensitive, however, to make the reduction of efficiency, caused by the lower feed-current, acceptable.

Even with these changes, the overall sensitivities of the new headset are considerably greater than those of the old and there were fears that this would cause complaints of excessive sidetone. Field trials in telephone exchanges showed that these fears were, however, unfounded. A factor contributing to this was the marked reduction in switch-room noise levels which accompanied a change to the new headset, due to the lower level at which operators found it necessary to speak. If only some instruments had been changed, or if background noise were high for other reasons, the result might not have been so favourable.

For P.B.X. use advantage can be taken of some, and often all, of the additional sensitivities of the headset. For these uses the values of the transmitter feed-current and the receiver shunt are adjusted to give the sending and receiving efficiencies required. In some P.B.X. circuits changes are also made to the balance circuit to reduce sidetone.

CONCLUSIONS

A new headset has been designed which is much lighter and more comfortable to wear than the old head-and-breast set. It has been enthusiastically welcomed by telephone operators. In spite of its small size and low weight, the headset is very robust, and extensive field trials have proved it to be a very reliable instrument.

The transmission performance of the new headset is markedly superior to its predecessor, both in sensitivity and frequency response. Its use enables the transmission performance of P.B.X. switchboard operators' instruments to be maintained with the recently extended transmission limits for local line networks.

ACKNOWLEDGEMENT

The headset has been developed for the Post Office by Standard Telephones and Cables, Ltd., under the British Telephone Technical Development Committee procedure.

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PATENT SPECIFICATION

Inventor: JAMES SAMUEL PATERSON ROBERTSON

776,896

Date of Application and filing Complete Specification April 29, 1955.

No. 12509/55.

Complete Specification Published June 12, 1957.

Index at acceptance:—Classes 13, 13(C: G); and 40(4), J(1A: 1B: 3A: 3E: 3R: 4B: 4D).

International Classification:—C10k. H04m.

COMPLETE SPECIFICATION

Improvements in or relating to Operator's Telephone Headsets

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to operators' telephone headsets. According to one aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband, and which includes a detachable and rotatable horn carried by the transmitter casing.

According to another aspect of the invention, there is provided an operator's telephone headset comprising an acoustic wave transmission column for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing. The cylindrical collar being capable of rotation on the connecting-piece.

The invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a general view of the set,

Fig. 2 shows the set partly dismantled,

Fig. 3 shows parts of the set after further dismantling.

Referring to Figs. 1—3, the transmitter assembly 1 and the receiver assembly 2 are carried by a base 3 and held in position by a flexible strap 4. A cover 5 encloses both assemblies. A pad 6 is carried by a headband 7 mounted by means of a ball 8 on the cover 5. An exponential horn 9 terminates in a collar 10 mounted on a connecting piece 11. The connecting piece 11 is adjustably mounted on an angle-piece 12 which is rotatably mounted on the base 3. The leads to the transmitter and receiver are carried in a cord 13 which passes through an aperture in the cover 5.

The angle piece 12 can be rotated through 180° from the position shown in the drawings. The collar 10 of the horn 9 can rotate around the connecting piece 11. By rotating the angle piece 12 and the horn 9 through 180° the set may be worn with equal convenience on either ear. The connecting piece 11 engages the angle-piece 12 in a flexible joint which permits the position of the horn 9 to be adjusted to suit the user. A ball-and-socket joint is used to connect the headband 7 to the cover 5 at the aperture 54. The connection at this joint is therefore also adjustable. The angle piece 12 is mounted on the base 3 below the receiver assembly 2. By moving the base 3 pendulum fashion about the ball-and-socket joint, the angle-piece 12 can be moved forward of or behind a vertical line passing through the centre of the receiver assembly 2. In this way the set can be adjusted to suit the distance between the ear and the mouth of any particular user.

The cover 5 is held to the base 3 by a lug 14, which engages with a stud 15, and by two screws 16. The head of each screw 16 is accommodated in a recess 17 on the outer surface of the cover 5. The shank of the screw 16 is held by a pillar 18 embossed on the inner surface of the cover 5. Each screw 16 engages with a hole 19 tapped in a ring 20, which is attached to the base 3 by a number of studs 21. The heads of the studs 21 are expanded rivet-fashion to hold the ring 20.

The studs 21 have a ledge 22 on the inner surface. The receiver assembly 2 rests on these ledges. The receiver assembly 2 is held in position by the flexible strap 4 which is secured to the ring 20 by three screws 23 engaging in tapped holes 24. Holes 25 in the strap 4 permit the passage of the screws 23. Two further holes 26 permit the terminals 27 of the receiver assembly 2 to pass through the strap 4.

[*Price 3s. 6d.*]

Ex. 47 215

To carry the transmitter assembly 1, two pillars 28, each with a ledge 29, are provided on the base 3. A third ledge 30 is also provided for this purpose. The ledge 30 is part of the outer surface of a hollow column 31 which is formed integrally with the base 3. The hollow core of the column 31 acts as part of the acoustic channel 39 leading from the horn 9. A hole 32 is provided in the column 31 at a position which is suited to the position of the microphone in the transmitter assembly 1. The hole 32 is surrounded by a rim 58 which serves as a seating for a polyvinylchloride washer (not shown) or similar resilient member which ensures an acoustically tight joint, when the transmitter assembly is in position. At the foot of the column 31, an inset 33 is held by two screws 34, the heads of which are expanded rivet-fashion. The inset 33 carries a tapped hole 35. The transmitter assembly 1 is held in position by the strap 4, the lower portion of which is secured by a screw 36 which passes through a hole 37 in the strap 4 to engage in the tapped hole 35 of the inset 33. When the screw 36 is tight, the strap 4 holds the transmitter assembly 1 with sufficient force to ensure a substantially acoustically tight joint at the hole 32. To assist in making a tight joint, a washer (not shown) is provided at the hole 32. To isolate the transmitter assembly acoustically from the base 3, the transmitter assembly carries an annular cushion (not shown) which bears on the ledges 29, 30. The transmitter assembly 1 has two terminals 38 to which the cord 13 is connected.

By undoing the appropriate screws 23, 36, the transmitter assembly 1 and the receiver assembly 2 can be removed from the base 3 independently of each other.

The horn 9 is connected to the base 3 by the connecting piece 11 and the angle-piece 12. Each piece has a hollow central bore forming part of acoustic channel 39 connecting the horn 9 to the microphone of thr transmitter assembly 1. The connecting piece 11 and the angle-piece 12 are held in their working positions by a helical spring (not shown) which is accommodated within the acoustic channel 39. One end of the spring is anchored to a cap 40 provided at the top of the column 31, a polythene washer 57 being provided between the cap 40 and the column 31 to ensure an acoustically tight joint. The other end of the spring is anchored to a washer 41 at the outer end of the connecting piece 11. The tension of the spring keeps the connecting piece 11 and the angle-piece 12 in position. Within the angle-piece 12, the acoustic channel 39 is composed on straight bores. If a uniformly curved bore is used, the spring acquires a bias resulting in an uneven action of the joint between the connecting piece 11 and the angle-piece 12 and in a reduction of pressure at one side of the joint between the angle-piece 12 and the base 3 to a value insufficient to keep the joint acoustically tight. The horn 9 is held in position by the friction between its collar 10 and the connecting piece 11 which the collar 10 fits closely. The presence of the spring within the acoustic channel 39 gives rise to acoustic damping and reduces the amplitude of standing waves which occur at certain frequencies.

The bearing surface of the angle-piece 12 against the base is provided with two cams 42 set 180° apart. The cams 42 engages with two recesses (not shown) provided at the foot of the column 31 in the base 3. The angle-piece 12 has therefore two stable positions, 180° apart, in relation to the base 3, in each of which the cams 42 engage in the recesses. A small clearance is allowed between the tops of the cams 42 and the bottoms of the recesses. This ensures that the pull-action of the spring is taken by the main bearing surfaces of the angle-piece 12 and of the base 3 so as to secure a substantially acoustically tight joint. The angle-piece 12 is provided with a fin 43, which comes into contact with the outer surface of the base 3 if an attempt is made to rotate of the angle-piece 12 beyond 180° from the position shown in the drawings. The face of the fin 43 which comes into contact with the surface of the base 3 is so inclined that, if rotation is continued beyond 180°, the angle-piece 12 is forced downward against the action of the helical spring in the acoustic channel 39. The check action thereby obtained is gradual and less likely to give rise to breakages than the positive action of a buffer stop. The check action also serves to discourage continuous rotation of the angle-piece 12 in one direction and to prevent the deleterious effect on the spring which such rotation would have.

The other end of the angle-piece 12, is indented to provide a seating 59 for a polythene washer 60. The seating 59 and the outer surface 61 of the washer 60 are in the shape of the frustrum of a cone. The inner surface 44 of the washer 60 is part of a sphere.

Under the influence of the helical spring, the connecting piece 11 beds against the surface 44 of the washer 60 and provides a substantially acoustically tight joint between the angle-piece 12 and the connecting piece 11.

At one end of the connecting piece 11 is a surface 45 which bears on the surface 44 of the washer 60. The surface 45 is formed from a hemisphere, part of which is cut away for the acoustic channel 39. The joint between the connecting piece 11 and the angle-piece 12 can therefore function as a ball-and-socket joint while remaining substantially acoustically tight. The angle of the horn 9, which depends on the position of the connecting piece 11, can therefore be varied without impairing the efficiency of the acoustic channel 39.

The surface 45 terminates in a shoulder 46. At the other end of the connecting piece 11 is a flat bearing surface 47 for the polythene washer 48, which is held in position by the

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action of the spring (not shown) on the washer 41.

The exponential horn 9 is made of nylon which will regain its shape after accidental deformation. The shape of the horn 9 is determined by the type of microphone used in the transmitter assembly 1 and is such as to give increasing efficiency above the frequency at which the efficiency of the mircophone begins to decrease. The horn 9 has a collar 10 enclosing a hollow brass inset which fits on to the connecting piece 11 and abuts the shoulder 46. The collar 10 and the connecting-piece 11 are dimensioned to give a push-fit. The action of the spring tends to make the connecting-piece 11 barrel shaped and so ensures adequate frictional contact. The joint is made acoustically tight by the washer 48.

The washers 48, 57 and 60 are made of polythene which has approximately the same coefficient of friction under static and moving conditions. The position of the horn 9 can therefore be varied without jerks.

On the inside of the cover 5 an inset 49, in the shape of a hollow square is carried by four studs 50, the heads of which are expanded rivet-fashion. A V-piece 51 is carried on the inset 49 by two screws 52. At the apex of the V is a socket 53 which receives the ball 8 of the headband 7 which penetrates the cover 5 at the aperture 54. The V-piece 51 is resilient and forces the ball 8 into contact with another socket (not shown) on the inner surface of the cover 5. The inset 49 clamps a piece of soft material 55 against the inner surface of the cover 5. The piece of soft material 55 prevents the entry of dust through the aperture 54. A short length of fine cord 56 is tied at one end to the inset 49 and at the other end to the cord 13, to act as a stain cord.

By using the construction described above, it is possible to effect an appreciable reduction in the weight of the operator's telephone headset. While conventional sets may weigh as much as 15½ ozs, a set constructed as described above weighs only 4 ozs.

What we claim is:—

1. An operator's telephone headset comprising an acoustic wave transmission column which is adapted to pass acoustic waves from the mouth towards a telephone transmitter carried by a headband and which includes a detachable and rotatable horn carried by the transmitter casing.

2. An operator's telephone headset comprising an acoustic wave transmission column, for passing acoustic waves from the atmosphere towards the telephone transmitter which is carried by a headband, the column including a curved horn terminating at its smaller end in a cylindrical collar, which forms a push-fit with a cylindrical connecting-piece terminating an acoustic channel extending from the transmitter casing, the cylindrical collar being capable of rotation on the connecting-piece.

3. An operator's telephone headst comprising an acoustic wave transmission column as claimed in Claim 2, wherein the cylindrical connecting-piece is carried by an angle-piece, is separate from the transmitter casing, and is carried thereby and held thereto by a helical spring which passes through the connecting-piece, the angle-piece and a passage in the transmitter casing, and which is anchored at both ends.

4. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece terminates in cam-extensions, which engage in complementary cam-recesses at the end of the passage in the transmitter casing; so that the knee-joint can be rotated between two positions 180° apart, in each of which positions the cam-extensions and the cam-recesses are in engagement, movement between said positions being possible by rotating said angle-piece around the axis of said passage in the transmitter casing and disengaging said cam-extensions and cam-recesses during rotation.

5. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 3, wherein the angle-piece carries a fin having an inclined face so sloped as to oppose rotation of the angle-piece between said two positions via one half-circle, and thereby to prevent the internal helical spring being continuously wound in the same direction.

6. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 5, wherein the acoustic passage in the angle-piece has a sharp turn to prevent imparting a bias to the helical spring, which would impair the action of the spring.

7. An operator's telephone headset comprising an acoustic wave transmission column as claimed in any of Claims 3—6, wherein the cylindrical connecting-piece has a rounded termination at one end, said termination engaging a co-operating recess at the end of the angle-piece, to form a ball and socket joint.

8. An operator's telephone headset comprising an acoustic wave transmission column as claimed in Claim 7, wherein the other end of the cylindrical connecting-piece carriers a resilient washer, held in place and compressed by a rigid washer, to which one end of the helical spring in achored, said resilient washer constituting an acoustic seal between the horn collar and the connecting-piece.

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Chartered Patent Agent,
For the Applicants.

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SHEET 1

FIG. 1.

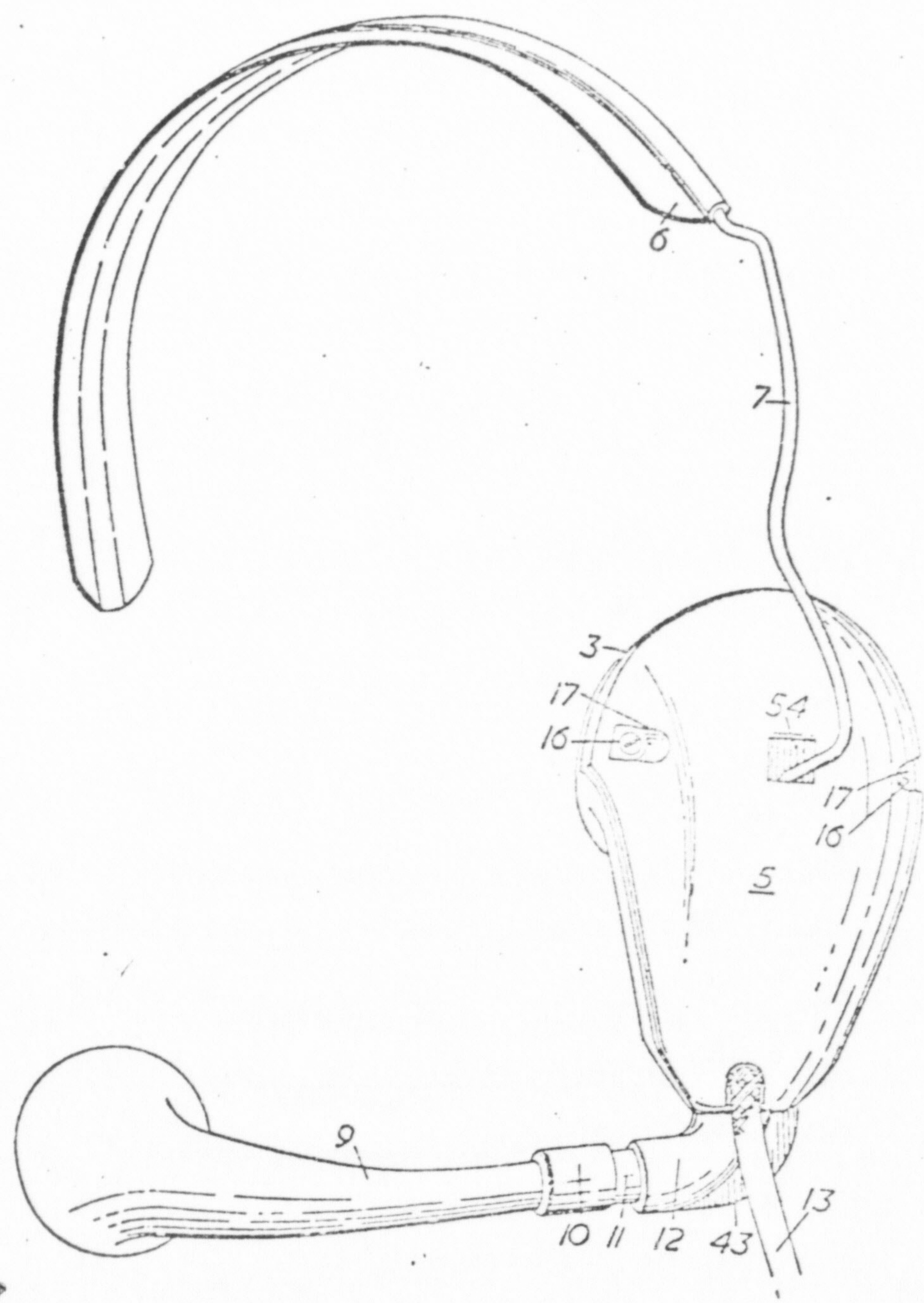

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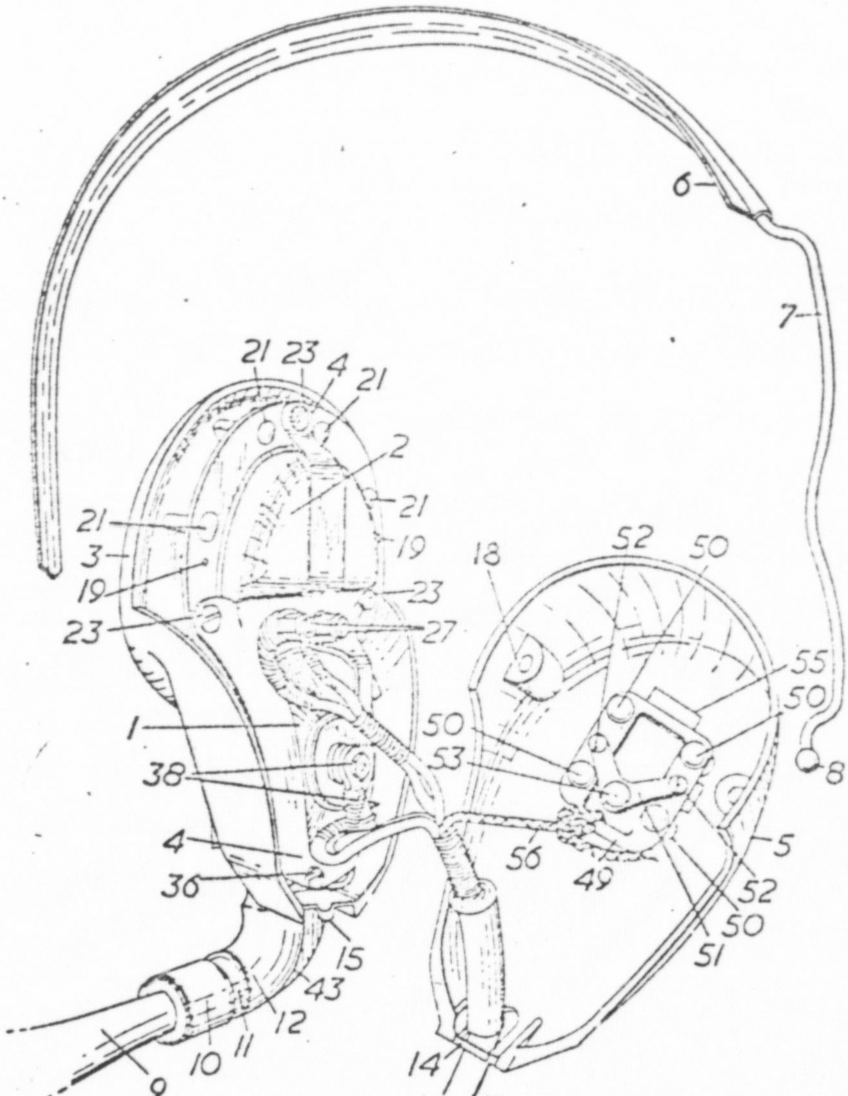
FIG. 2.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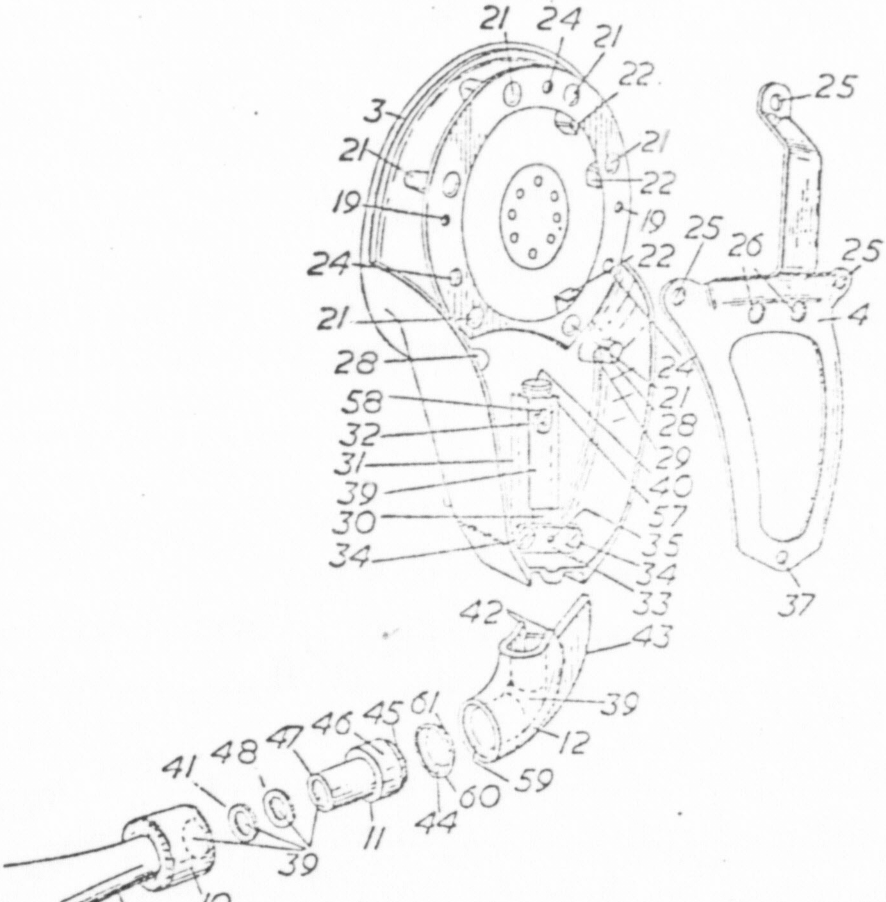
SHEETS 2 & 3

FIG. 3.



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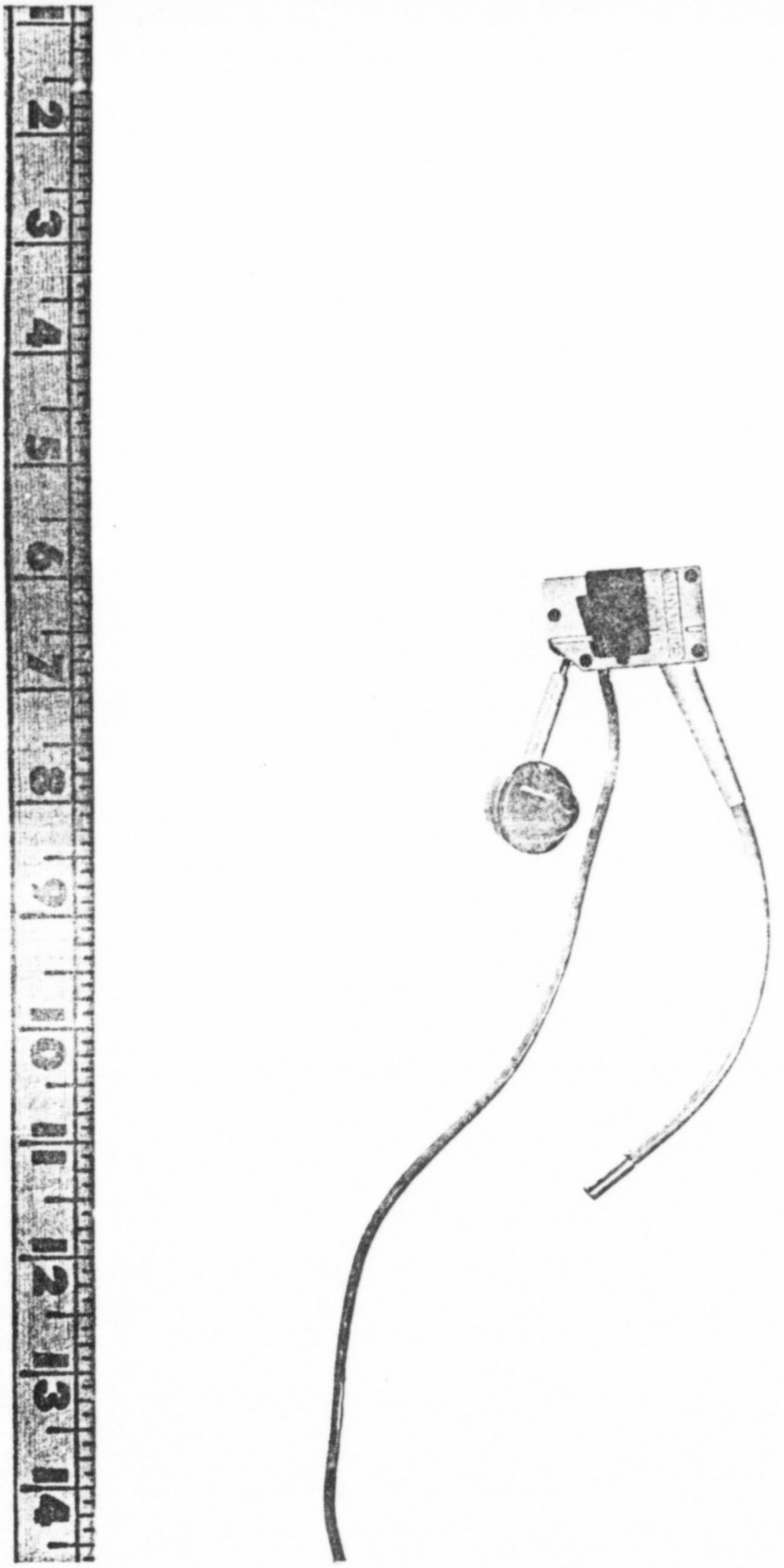

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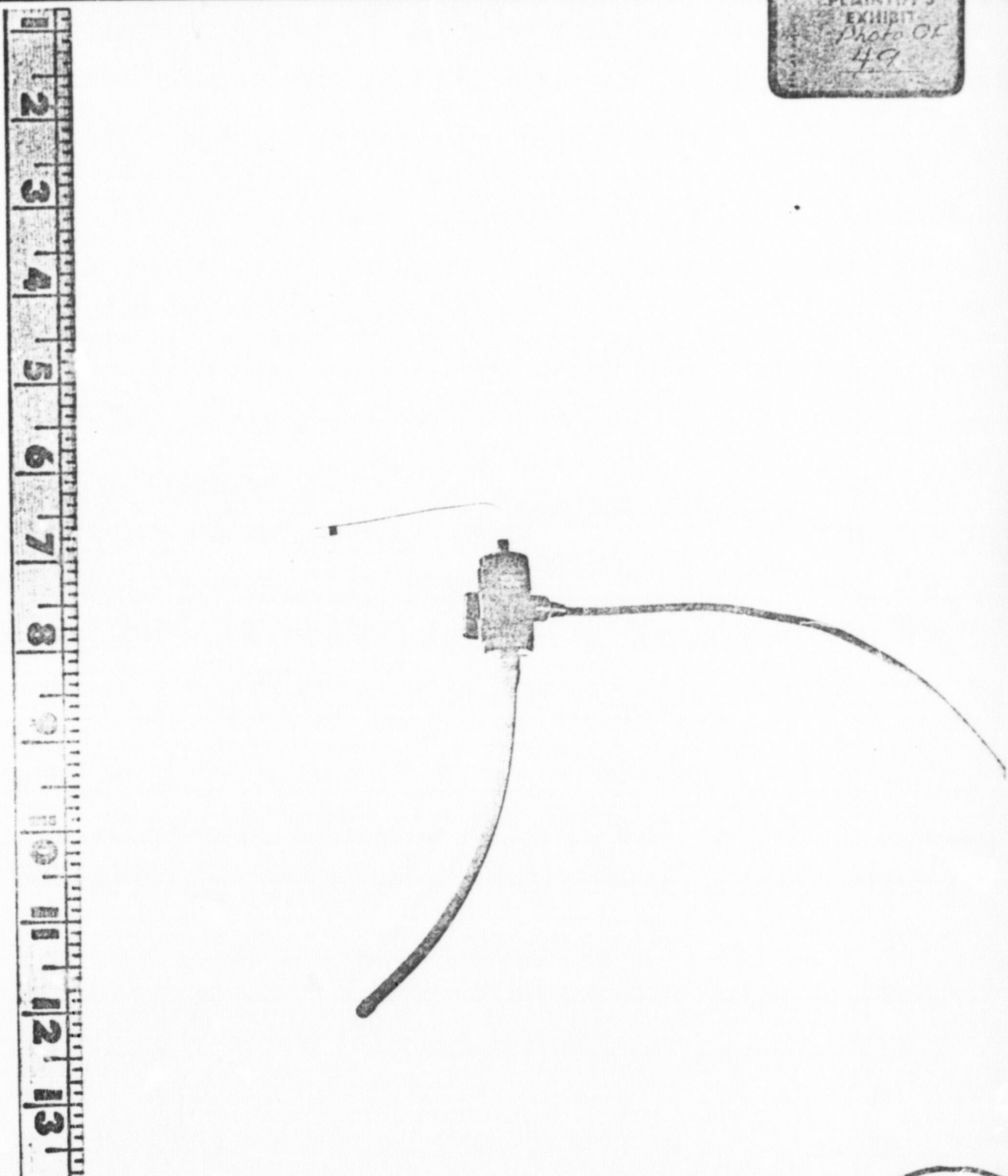

Ex. 49 222

PLAINTIFF'S EXHIBIT

158463

P. R. Div.		PATENT NUMBER
Cooper	Class 179	DATED
	DEC. 11, 1961	158463

WALLACE KEITH OF SANTA CRUZ, CALIF.

This is to certify that annexed hereto is a true copy from the records of the United States Patent Office of File Wrapper and Contents of the file identified above.

By authority of the
COMMISSIONER OF PATENTS

W. B. Walden
Certifying Officer

Date APR 9 1974

436 [redacted]

OMM-DC-55387

158463 SERIAL NO. (Series of 1960)	P. R. Div.		PATENT NUMBER 3184556 DATED MAY 18 1965
Assistant examiner Cooper	Class 179	Subclass 156	CLAIMS FOREIGN PRIORITY
GROUP 230	Filed complete (Date) DEC. 11, 1961	Serial No. 158 463	Country / Date

Applicant(s)

LARKIN, WALLACE KEITH OF SANTA CRUZ, CALIF.

None

Number claims allowed	Print claim	Class	Subclass
6	1	179	156

Assignor to Plantronics, Inc., Santa Cruz, Calif., a corp. of California

Title of invention

MINIATURE HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

☐ Division of ☐ Continuation of ☐ Continuation-in-part of

☐ Substitute for abandoned

None

APPLICATION

Serial No. / Filed

New Patent No. / Granted

Dr. dw.	Extra claims	Filing fee		Transaction	Atty's docket
3			$30	69870	1625

Send correspondence to:

~~ALLEN AND CHROMY~~ J. C. Chognard

~~P. O. BOX 905~~ P. O. Box 406

~~LOS GATOS, CALIF.~~ Palo Alto, California

Principal attorney(s)

~~ALLEN AND CHROMY~~

J. C. Chognard

192

Associate attorney(s)

3/31/...

PARTS OF APPLICATION FILED SEPARATELY

PREPARED FOR ISSUE

Cooper (Assistant Examiner) L. Graves (Docket Clerk)

EXAMINED AND PASSED FOR ISSUE

Robert G Rose (Primary Examiner) 250 (Division)

NOTICE OF ALLOWANCE MAILED

FEB 18 1965

FINAL FEE

Date MAR 30 1965 Amount

[THIS SPACE RESERVED] [THIS SPACE RESERVED]

158463

ALLEN AND CHROMY
PATENTS AND TRADEMARKS
P. O. BOX 505 · LOS GATOS, CALIFORNIA

HARPER ALLEN
OF THE CALIFORNIA BAR

Dec. , 1951

Hon. Commissioner of Patents
Washington 25, D. C.

Sir:

Please find [illegible]

[illegible]

225

101-A

14801
158463

MAIL ROOM DEC 11 1961 U.S. PATENT OFFICE

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN, that I, WALLACE KEITH LARKIN, a citizen of the United States of America, residing at Santa Cruz, in the County of Santa Cruz, State of California, have invented certain new and useful improvements in

MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

of which the following is a specification:

This invention relates to miniature type sound translating apparatus which is provided with a tuned acoustical tube to improve the frequency response characteristic and also to enable the apparatus to be used either with or without masks such as oxygen masks employed by airline pilots.

An object of this invention is to provide an improved sound translating apparatus adapted to be used with communications apparatus employed in vehicles such as airplanes in which the pilot is sometimes required to wear a mask such as an oxygen mask.

Still another object of this invention is to provide a tuned acoustical tube with a miniature type microphone to mechanically alter the frequency response of the microphone by removal of certain objectionable frequencies and also to alter the microphone primary frequency response curve.

A further object of this invention is to provide an improved arrangement for attaching a sound translating device, such as is used by airline pilots, to the temple bar of sun glasses or other glasses worn by the pilots

Still another object of this invention is to provide an improved sound translating apparatus that may be worn by an airline pilot and which is provided with means whereby a mask, such as an oxygen mask, which the pilot may have to wear occasionally, does not interfere with the transmission of the pilot's voice to the microphone which is supported on the temple bar of the glasses worn by the pilot.

Still another object of this invention is to provide an improved arrangement for supporting the microphone near the user's ear, said microphone being provided with a plastic acoustic tube having an air column therein the open end of which is adapted to be positioned adjacent to a corner of the user's mouth, or attached to a diaphragm cavity of the oxygen mask when said mask is worn by the user of the microphone.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification, claims and drawings in which briefly:

Fig. 1 is a view showing this invention employed in combination with an oxygen mask;

Fig. 2 is a view of this invention employed without the oxygen mask;

Fig. 3 is a sectional view taken along the line 3-3 of Fig. 1;

Fig. 4 is a side view of the fitting provided for supporting the microphone and receiver;

Fig. 5 is a sectional view taken along the line 5-5 of Fig. 4;

Fig. 6 is a detailed view showing the manner in which the fitting shown in Figs. 4 and 5 is supported on the temple

bar of the pilot's eyeglass frame, a portion of the temple bar being shown in broken lines;

Fig. 7 is an end view of the fitting shown in Figs. 4, 5 and 6; and

Fig. 8 is a schematic view of the pilot's and co-pilot's compartment in an aircraft showing the manner in which this invention is adapted to be used.

Referring to the drawing in detail, there is shown in Fig. 1 an embodiment of this invention employed in combination with an oxygen or smoke mask such as is provided to airline pilots, navigators and other personnel having communications responsibilities. In Fig. 2 there is shown an embodiment of this invention employed by the communications apparatus operator or pilot after removal of the mask. The small fitting 10 which may be made of metal or plastic material is provided for the purpose of supporting a microphone the telephone receiver or other sound translating apparatus or transducers on the temple bar 11 of the eye glass frame worn by the operator or pilot. A spring clip device 12, such as shown in Figs. 5, 6, and 7, is provided for this purpose. The clip 12 is shaped so that the end portions 13 and 14 thereof form hooks which clip over one side of the temple bar 11, as illustrated by the hook 14 shown in Fig. 7, and the middle part 15 of this spring clip is bent back upon itself as shown in Fig. 6 to form an opposing hook adapted to be clipped over the other side of the temple bar 11, also as shown in Fig. 7.

The fitting 10 is provided with a button member 17 which extends from the inner side of this fitting and which is provided with a keystone shaped portion 17a that is anchored in a suitable cavity in the fitting 10 by means of the cement,

plastic or other potting material 18 as shown in Fig. 5. The projecting portion of this button 17 is provided with a circumferential groove in which the arcuate portions 15 and 16 of the clip member 12 are adapted to be resiliently lodged as shown in Figs. 5 and 6. Thus the fitting 10 may be detachably attached to the temple bar 11 and it may also be detached from the clip member 12 if desired.

The fitting 10 is also provided with additional cavities for receiving the transducers 19 and 20 which comprise the microphone and receiver of a communications apparatus such as is employed by the pilot and co-pilot of an aircraft. These devices 19 and 20 are positioned in their respective cavities in the fitting 10 and they are held therein by a thin layer of plastic, cement, or potting material 21 and 22 respectively. Both the microphone 19 and receiver 20 are of the miniature type such as are used in hearing aids.

The microphone 19 is provided with a short tubular extension 23 which is hollow and to which the cap 24 is adapted to be attached. Thus the projection 23 extends into the cavity 25 of the cap 24 so that sound transmitted through the plastic or other flexible tube 26 and tubular connection 27 into the cavity 25 passes through the hollow extension 23 into the microphone 19. A suitable flexible or resilient gasket 23_a_ may be provided between the cap 24 and the extension or projection 23 of the microphone and this gasket is preferably sufficiently flexible or resilient to hold the cap 24 assembled on the microphone and also to permit the cap 24 to be rotated with respect to the microphone 19.

The receiver 20 is also provided with a hollow extension or projection similar to the projection 23 of the

microphone 19 so that sound generated in the receiver 20 may be readily passed into the cavity of the cap 28 which is similar to the cap 24. The ear tube 29 is attached to the cap 28 by means of the coupling member 30 so that the sound from the cavity of the cap 28 is passed through this ear tube 29 into the operator's ear.

The plastic tube 26 is made of yieldable material which may be formed into predetermined shape so that the lower end thereof may be placed either in the fitting 31 of the mechanical microphone that is supported on one side of the oxygen mask, as shown in Fig. 1, or this lower part of the plastic tube 26 may be positioned at the corner of the operator's mouth, as shown in Fig. 2, when the operator does not wear the oxygen mask. The mechanical microphone unit positioned in the mask is intended to eliminate the conventional electrical microphone which is now an integral part of the oxygen and smoke masks used in military and commercial jet aircraft.

The fitting 31 in which the lower end of tube 26 is positioned is shown in cross-section in Fig. 3 and it is threaded to the tubular hollow member 32 to which the lower end of the plastic tube 26 is adapted to be frictionally attached. The mask is made up of an outer body member 33 which may be made of relatively rigid material and an inner lining 34 of resilient material such as rubber. The tubular member 32 extends through both of these layers 33 and 34, as shown in Fig. 3, and is integral with the diaphragm housing member 35 of the mechanical microphone so that one side of this member is clamped against the resilient liner 34 of the mask when the fitting 31 is tightened up against the

outer mask member 33. The tubular member 32 is provided with a hollow channel 36 which communicates with the compartment 37 behind the diaphragm 38 and it also communicates with the channel through the plastic tube 26. A diaphragm 38 is held in the member 35 on the shoulder 35a by the cap 39 which is provided with an inner annular member that is adapted to engage the peripheral outer part of the diaphragm and press this diaphragm against the shoulder 35a. Cap 39 is also provided with an outer annular portion 39c which is threaded to the outside of the diaphragm housing 35.

A plurality of holes 40 is also provided to the central portion of the cap 39 so that sound may readily enter the inside of this cap to impinge the diaphragm 38. Thus sound vibrations impinge the diaphragm 38 and vibrate the air column extending all the way from the inner surface of the diaphragm 38 to the surface of the diaphragm (not shown) in microphone 19. The air column starting in the microphone cavity 25 and passing through fitting 27, plastic tube 26 and tubular member 32, which opens into the diaphragm cavity 37 of the mechanical microphone provides acoustic tuning to the miniature type microphone and alters mechanically the frequency response of the microphone. The tube 26 is preferably made of irradiated polyolefin plastic such as polypropylene made by the Alpha Wire Company and the desired acoustic tuning for the miniature type microphone is accomplished by controlling the length, diameter and wall thickness of this tube. The use of such a tuned acoustical system with a miniature type microphone is done for the specific purpose of removing a series of inherent deficiencies due to the miniature size of these microphones which has previously precluded their use in general audio communication

applications.

Thus the tuned acoustical tube in this invention functions to substantially remove certain objectionable frequencies or bands of frequencies prominent in background noise in any specific environment and it also functions to alter the primary frequency response curve of the microphone particularly in the lower spectrum to allow use of the miniature type microphone in areas of voice communication, such as, aircraft, switchboard, teaching machines etc., where space and weight savings are important.

In some installations, it may be desirable to provide a small opening from cavity 37 to the exterior through the wall of the housing 35 so that air pressure therein may be equalized to the air pressure in the gas mask, or oxygen mask. This small opening, however, should not be so large as to compare in cross-section with the cross-sectional area of the passage [illegible].

One of the advantages of this invention is that the microphone 19 and receiver 20 may be worn on either side of the operator's head. Thus the pilot sitting in seat 41 in the aircraft pilot's compartment, shown in Fig. 8, may wear the microphone and receiver on his right hand side of his head and the spring clip 12 that is provided for attaching the fitting 10 to the temple bar 11 is constructed so that this fitting may be attached either to the right hand temple bar or to the left hand temple bar as desired. Also the cap 24 for the microphone and cap 25 for the receiver are adapted to rotate with respect to these elements so that the plastic tubes 26 and 29 attached thereto may be positioned at the desired angles with respect to the fitting 10. Thus the pilot occupying seat 41 has the electrical connections 44

from his microphone and receiver connected to the communication apparatus coupling box 42 which is attached to the fuselage of the aircraft, and the co-pilot occupying the seat 42 being provided with a microphone and receiver attachment on the left hand side of his head has the electrical connections 45 thereto coupled to the coupling box 43 of the communications apparatus.

While I have shown and described a preferred embodiment of the invention, it will be understood that the invention is capable of variation and modification from the form shown so that its scope should be limited only by the scope of the claims appended hereto.

WHAT I CLAIM IS:

Add B'

1. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver adjacent to the wearer's ear, a first ~~an~~ acoustical tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being adapted to be positioned adjacent to the wearer's mouth, ~~said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise~~.

B

2. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver adjacent to the wearer's ear, a first ~~an~~ acoustical tube made of plastic material, means for attaching one end of said first tube to said microphone, said first ~~plastic~~ tube being yieldable and adapted to be formed to a predetermined shape so that the other end of said first tube may be positioned adjacent to the wearer's mouth, a2 ~~said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise.~~

Ins a2

3. A miniaturized microphone head set ~~employing a miniature microphone of the type used in hearing aids~~ comprising the combination set forth in Claim 2 further comprising a diaphragm ~~mechanical microphone~~ supported in an oxygen or smoke mask said ~~mechanical microphone~~ having means for attaching said other end of said first tube thereto.

4. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver adjacent to the wearer's ear, said means including clip means adapted to be attached either to the right or left temple ear of the wearer's eye glasses, ~~an~~ a first acoustical tube made of [illegible] material, means for attaching one end of said first tube to said microphone and the other end of said first tube being positioned adjacent to the wearer's mouth, A3 ~~said tube being proportioned to remove the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise.~~

5. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver adjacent to the wearer's ear, ~~an~~ a first acoustical tube made of polyolefin plastic, means for attaching one end of said first tube to said microphone and the other end of said first tube being positioned adjacent to the wearer's mouth, A4 ~~said tube being proportioned to remove the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise.~~

6. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver of the head set adjacent to the wearer's ear, said means comprising a member having cavities for receiving said microphone and said receiver, a resilient clip, means for attaching said clip to said member, said clip having means for resiliently gripping the temple bar of the wearer's eyeglasses frame so that said microphone and said receiver are supported adjacent to the wearer's ear, ~~an~~ a first acoustic tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being positioned adjacent to the wearer's mouth, ~~[illegible] background noise~~.

7. A miniaturized microphone head set ~~employing a miniature microphone of the type used in hearing aids~~ comprising the combination set forth in Claim 6 further comprising a ~~mechanical microphone~~ diaphragm supported in an oxygen or smoke mask, said ~~mechanical microphone~~ diaphragm having means for attaching said other end of said first tube thereto.

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6. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver of the head set adjacent to the wearer's ear, said means comprising a member having cavities for receiving said microphone and said receiver, a resilient clip, means for attaching said clip to said member, said clip having means for resiliently gripping the temple bar of the wearer's eyeglasses frame so that said microphone and said receiver are supported adjacent to the wearer's ear, a first ~~an~~ acoustic tube made of polypropylene, means for attaching one end of said first tube to said microphone and the other end of said first tube being positioned adjacent to the wearer's mouth, ~~[illegible]~~ a6

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a6

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~~[illegible] and also to remove objectionable background noise.~~

9. A miniaturized microphone head set employing a miniature microphone and a miniature receiver ~~of the type used in hearing aids~~ comprising the combination of means for detachably supporting the miniature microphone and miniature receiver of the head set adjacent to the wearer's ear, said means comprising a member having cavities for receiving said microphone and said receiver, a resilient clip, means for attaching said clip to said member, said clip having means for resiliently gripping the temple bar of the wearer's eyeglasses frame so that said microphone and said receiver are supported adjacent to the wearer's ear, a first acoustical ~~an acoustic~~ tube, means for attaching one end of said first tube to said microphone, a ~~mechanical~~ microphone comprising a diaphragm and a housing for said diaphragm, said housing having means for attaching it to an oxygen or smoke mask for supporting said diaphragm inside of said mask, said housing also having means for attaching the other end of said first tube thereto so that the air column in said first tube communicates with the cavity behind said diaphragm, ~~said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise.~~ A1

B

10. The miniaturized microphone head set as described in the specification and illustrated in the drawing.

~~Add A1~~

~~Add B1~~

APPLICATION FOR UNITED STATES PATENT

Oath, Power of Attorney, and Petition

Being duly sworn, I, WALLACE KEITH LARKIN
depose and say that I am a citizen of THE UNITED STATES OF AMERICA residing at SANTA CRUZ STATE OF CALIFORNIA; that I have read the foregoing specification and claims and I verily believe I am the original, first, and sole inventor of the invention or discovery in MINIATURE HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

described and claimed therein; that I do not know and do not believe that this invention was ever known or used before my invention or discovery thereof, or patented or described in any printed publication in any country before my invention or discovery thereof, or more than one year prior to this application, or in public use or on sale in the United States for more than one year prior to this application; that this invention or discovery has not been patented in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than twelve months before this application; and that no application for patent on this invention or discovery has been filed by me or my representatives or assigns in any country foreign to the United States, except as follows:

And I hereby appoint Allen and Chromy, P. O. Box 905, Los Gatos, California, Registration No. [illegible] my attorney or agent with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith.

Wherefore I pray that Letters Patent be granted to me for the invention or discovery described and claimed in the foregoing specification and claims, and I hereby subscribe my name to the foregoing specification and claims, oath, power of attorney, and this petition, this

8th day of DECEMBER, 1961.

Inventor *Wallace Keith Larkin*
First name WALLACE Middle initial KEITH LARKIN Last name

Post Office Address: 74 HOLLINS DRIVE
SANTA CRUZ, CALIFORNIA

State of CALIFORNIA
County of SANTA CLARA } SS

Before me personally appeared WALLACE KEITH LARKIN,
to me known to be the person described in the above application for patent, who signed the foregoing instrument in my presence, and made oath before me to the allegations set forth therein as being under oath, on the day and year aforesaid.

Elza C. Cavallaro
Notary Public

SEAL

My commission expires 11/2/63

This form may be executed only when attached to a complete application as the last page thereof.

Approved Single Signature Form

179-156 158463

FIG_7

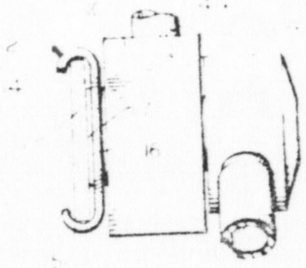


FIG_3

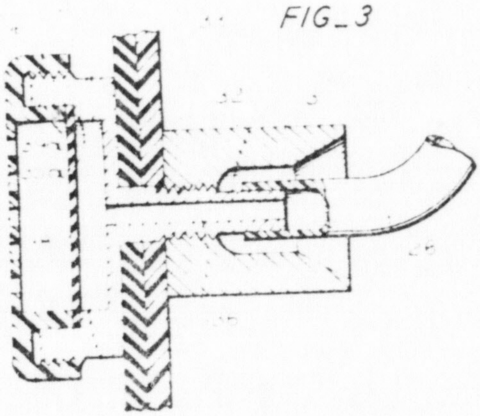


FIG_4

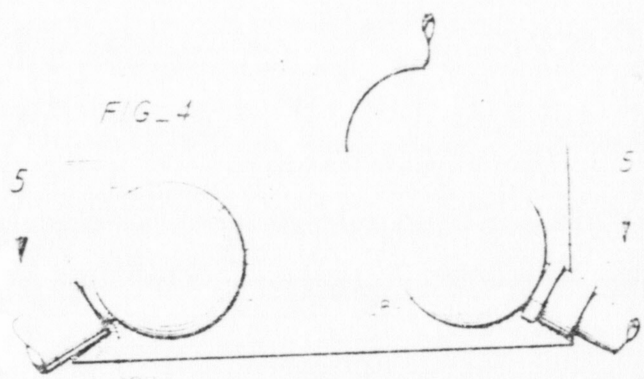
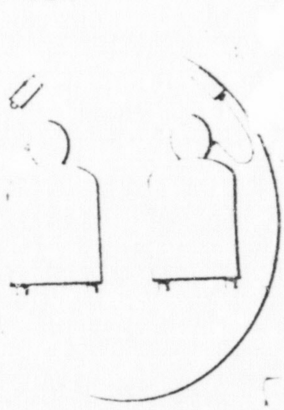


FIG_8



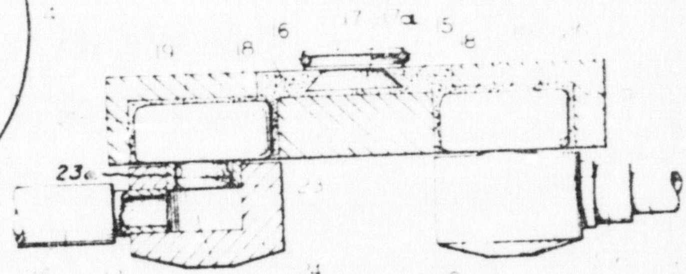
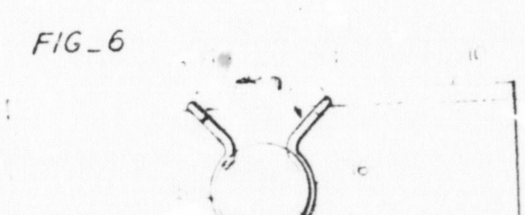


FIG_5

FIG_6



INVENTOR.

WALLACE KEITH LARKIN

BY

Allen and Graham

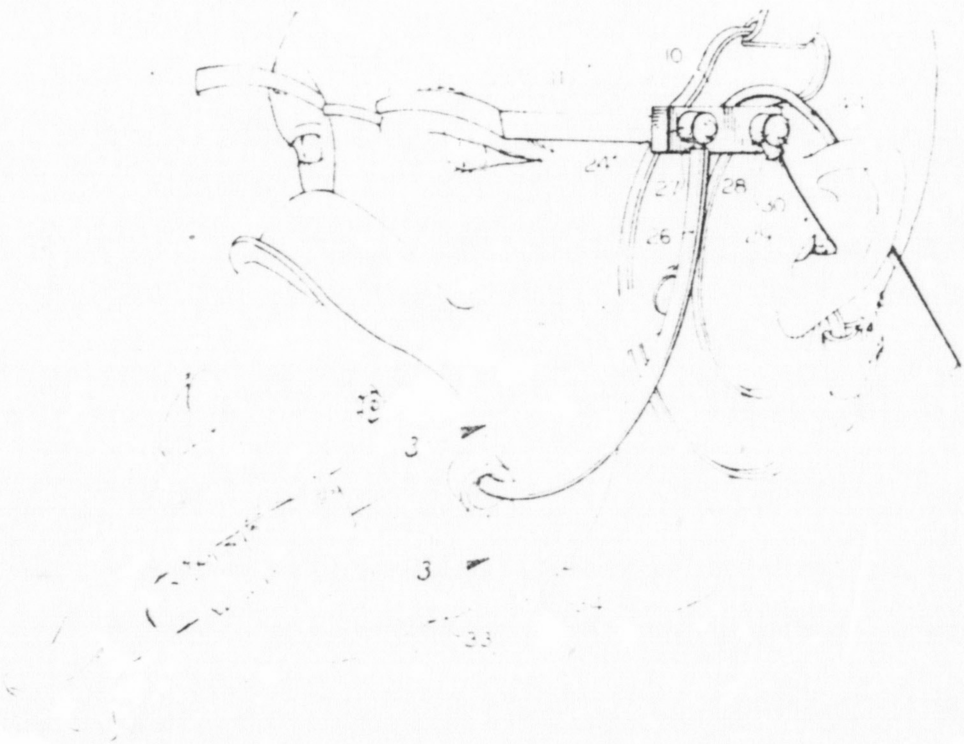
15

158463

1961 D 27 12

PRINT OF DRAWINGS AS
ORIGINALLY FILED

FIG_1



INVENTOR.
WALLACE KEITH LARKIN
BY
Allen and Cherny

FIG_2

16

#3

IN THE
UNITED STATES PATENT OFFICE

DIVISION ROOM

Wallace Keith Larkin

SEP 1 1962

Div. 10 Filed

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25, D. C.

SIR:

REVOCATION OF POWER OF ATTORNEY AND APPOINTMENT OF SUBSTITUTE ATTORNEY

Pacific Plantronics, Inc., Assignee of the entire right, title and interest in the above-identified patent application, hereby revokes the Power of Attorney of Allen and Chromy, P. O. Box 905, Los Gatos, California, and appoints in their stead J. C. Chognard, Registration No. 16,531, P. O. Box 406, Palo Alto, California. Please forward all future correspondence to the substitute attorney.

PACIFIC PLANTRONICS, INC.

By Wallace Keith Larkin
Wallace Keith Larkin

JCC:ba
29 Aug 62

60001

FORM PO-1.
(9-1-50)

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE

#3 1/2

TITLE REPORT

NO. 158463

NAME Wallace K. Larkin

THE TITLE APPEARS FROM THE ASSIGNMENT RECORDS TO BE VESTED IN

Plantronics, Inc., Santa Cruz, Calif.,

a corp. of California.

EXAMINED UP TO AND INCLUDING Sept. 20,1962.

THIS CERTIFICATE DATED Nov. 1,1962.

HEAD OF ASSIGNMENT BRANCH

NO FURTHER ASSIGNMENTS APPEAR TO HAVE BEEN RECEIVED FOR RECORD INCLUDING:

18

COMM-DC 67100

#4

FORM PO-122
(9-1-50)

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE

Suppl

TITLE REPORT

NO. 158463

NAME Wallace K. Larkin

THE TITLE APPEARS FROM THE ASSIGNMENT RECORDS TO BE VESTED IN:

Plantronics, Inc., Santa Cruz, Calif.,

a corp. of California.

EXAMINED UP TO AND INCLUDING Oct. 29,1962.

THIS CERTIFICATE DATED Dec. 10,1962.

SGD. F. TULE

HEAD OF ASSIGNMENT BRANCH

NO FURTHER ASSIGNMENTS APPEAR TO HAVE BEEN RECEIVED FOR RECORD INCLUDING: 12/3/62

2-1-63

19

COMM-DC 67106

#5

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON 25, D. C.

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON

FJM/cvb

February 8, 1963

In re: Application of
Wallace Keith Larkin
Serial No. 158463
Filed Dec. 11, 1961
Div. 16

J. C. Chognard
P.O. Box 406
Palo Alto, California

Sir:

Receipt is acknowledged of a paper, signed by Pacific Plantronics, Inc., alleged assignee, appointing you as attorney and revoking all previous powers.

However, said paper remains unentered in view of a report from the Assignment Branch which states that title appears to remain vested in: Plantronics, Inc. through the date of Dec. 3, 1962.

Sincerely yours,

E. D. Carter
Head, Docket Branch
per M.

10

W

#6

IN THE
UNITED STATES PATENT OFFICE

DIVISION 16 ROOM

Patent Office
APR 4 1963
DIV. 16 Filed

Wallace Keith Larkin

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25. D. C.

SIR:

REVOCATION OF POWER OF ATTORNEY AND APPOINTMENT
OF SUBSTITUTE ATTORNEY

Plantronics, Inc., assignee of the entire right, title and interest in the above-identified patent application, hereby revokes the Power of Attorney of Allen and Chromy, P. O. Box 905, Los Gatos, California, and appoints in their stead J. C. Chognard, Registration No. 16,531, P. O. Box 406, Palo Alto, California. Please forward all future correspondence to the substitute attorney.

Plantronics, Inc.

By ______________
President

JCC:ba
26 March 63

51

-160001

PO-53
REV.

ADDRESS ONLY
THE COMMISSION OF PATENTS
WASHINGTON 25, D. C.

U.S. DEPARTMENT OF COMMERCE

PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

PAPER NO. 7 bb

April 9, 1963

J. C. Chognard
P. O. Box 406
Pala Alts, Calif.

Applicant Wallace K. Larkin

Serial No. 15846[illegible]

Filed Dec. 11, 1961

Div. 1[illegible]

In this application the Commissioner of Patents has accepted the power of attorney for the above named person or firm. The ~~applicant~~ assignee has revoked the power of attorney to the person or firm named below.

E. D. Carter

Head, Docket Branch

Allen & Chromy
P. O. Box 905
Los Gatus, Calif

POL-90
5-9-61

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON 25, D. C.

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

PAPER No. 8

J. C. Chognard
P.O. Box 406
Palo Alto, California

Applicant: Wallace Keith Larkin	
Ser. No. 158,463	MAILED
Filed Dec. 11, 1961	JUN 11 1963
For MINIATURE HEADSET MICROPHONE ADAPTED FOR USE WITH A MASK	PAT. DIV. 16

16—68457-5 GPO

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents.

This application has been examined.

References:

Olney et al.	2,485,405	Oct. 18, 1949	179-102
Rackham et al.	2,717,932	Sept. 13, 1955	179-187 X
Dreher et al.	2,904,640	Sept. 15, 1959	179-156

Claims 1-9 are rejected as vague and indefinite. A microphone "of the type used in hearing aids" is not definite. A tube "proportioned to improve the response" etc. is lacking in structure. This is claiming results rather than structure. In claims 5, 7 and 9, what is a "mechanical microphone"? In claims 4, 6 and 8 there is no antecedent for the eyeglasses.

Claims 1 and 2 are further rejected as fully met by Dreher et al.

Claim 10 is rejected for failing to particularly point out and distinctly claim the invention as required in 35 U.S.C. 112.

Note tuning of the tube in Olney and Rackham, also combined mounting of microphone and receiver in Olney.

WCCooper:dlh

W C Cooper
Examiner

93

ER

/9/a

IN THE

UNITED STATES PATENT OFFICE

DIVISION (16) ROOM

RECEIVED

DEC 11 1963

GROUP 200

ljg

Wallace Keith Larkin

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25. D. C.

SIR:

In answer to the Office Action dated June 11, 1963, please amend the above-identified patent application as follows:

Claim 1, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 1, line 4, after "microphone" insert -- and miniature receiver --;

Claim 1, line 5, cancel "an" and insert -- a first --;

Claim 1, line 5, after "said" insert -- first --;

Claim 1, line 6, after "said" (second occurrence) insert -- first --;

Claim 1, line 7, before "positioned" insert -- adapted to be --;

Claim 1, line 7, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube

a'

being adapted to be plugged into the wearer's ear --;

Claim 2, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 2, line 4, after "microphone" insert -- and miniature receiver --;

Claim 2, line 4, cancel "an" and insert -- a first --;

Claim 2, line 6, before "tube" insert -- first --; cancel "plastic" and insert -- first --;

Claim 2, line 8, before "tube" insert -- first --;

Claim 2, line 9, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

Claim 3, lines 1 and 2, cancel "employing a miniature microphone of the type used in hearing aids";

Claim 3, line 4, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 3, line 5, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 3, line 6, before "tube" insert -- first --;

Claim 4, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 4, line 4, after "microphone" insert -- and miniature receiver --;

Claim 4, line 7, cancel "an" and insert -- a first --;

Claim 4, line 8, before "tube" insert -- first --;

Claim 4, line 9, before "tube" insert -- first --;

Claim 4, line 10, cancel "said tube being proportioned to improve the response of said miniature microphone in the

portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

a3

Claim 5, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 5, line 4, after "microphone" insert -- and miniature receiver --; cancel "an" and insert -- a first --;

Claim 5, line 6, before "tube" insert -- first --;

Claim 5, line 7, before "tube" insert -- first --;

Claim 5, [illegible] being proportioned to [illegible]

[illegible] one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

a4

Claim 6, line [illegible], cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 6, line [illegible], cancel "an" and insert -- a first --;

Claim 6, line [illegible], before "tube" insert -- first --;

Claim 6, line [illegible], before "tube" insert -- first --;

Claim 6, line [illegible], cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

a5

- 5 -

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FORM PO-98 (7-64)

U.S. DEPARTMENT OF COMMERCE PATENT OFFICE

PAPER NO.: 12 14812

Claim 7, [illegible] and 2, cancel "employing a minia[illegible]e microphone of the type used in hearing aids";

Claim 7, line 4, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 7, line 5, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 7, line 6, before "tube" insert -- first --;

Claim 8, line [illegible], cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 8, line [illegible], cancel "an" and insert -- a first --;

Claim 8, line [illegible], before "tube" insert -- first --;

Claim 8, line [illegible], before "tube" insert -- first --;

[illegible] being proportioned to improve [illegible] portion [illegible] frequencies and also to [illegible] and insert -- a second [illegible] end of said second tube to said [illegible] and the other end of said second tube being adapted to be inserted into the wearer's ear --;

a6

Claim 9, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 9, line 11, cancel "an acoustic" and insert -- a first acoustical --;

Claim 9, line 12, before "tube" insert -- first --; cancel "mechanical";

Claim 9, line 17, before "tube", first and second occurrences, insert -- first --;

Claim 9, line 18, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second

a7

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a7

acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of second tube being adapted to be placed [illegible] the wearer's ear.

B

Cancel claim 10.

Add the following claim:

11. A miniaturized microphone headset comprising a miniature microphone [illegible] a first acoustical tube connected thereto, and a [illegible] receiver with a second acoustical tube connected thereto.

a8 B

REMARKS

Claims 1 to 9 have been amended to remove the expressions "of the [illegible]" and "[illegible]" [illegible]

[illegible]

that there is no [illegible] for the wearer's eyeglasses. This rejection is respectfully traversed. The wearer's eyeglasses are not a part of the combination claimed, any more than the wearer's ear or the wearer's mouth. Means for gripping the wearer's eyeglasses simply defines the kind of clip used, which clip is part of the combination claimed.

All the claims have been amended to define a headset in which the tranducers are held adjacent to the wearer's ear, and in which two tubes are used, one from the microphone to the mouth and the other from the receiver to the ear. This arrangement is not shown by Dreher who only has one tube, nor by the other art cited by the Examiner. Applicant's claimed device is particularly light and comfortable to wear.

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Favorable action is solicited.

Respectfully submitted,

Wallace Keith Larkin

By [signature]
Attorney

JCC/cb
6 Dec. 1963

253A

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FINAL FEE TRANSMITTAL

U.S. Department of Commerce
Patent Office

MAIL DEC 9 1963 U.S. PATENT OFFICE

IN THE

UNITED STATES PATENT OFFICE

DIVISION 16 ROOM

RECEIVED

DEC 11 1963

GROUP 230

Wallace Keith Larkin

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25. D. C.

SIR:

In answer to the Office Action dated June 11, 1963, please amend the above-identified patent application as follows:

Claim 1, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 1, line 4, after "microphone" insert -- and miniature receiver --;

Claim 1, line 5, cancel "an" and insert -- a first --;

Claim 1, line 5, after "said" insert -- first --;

Claim 1, line 6, after "said" (second occurrence) insert -- first --;

Claim 1, line 7, before "positioned" insert -- adapted to be --;

Claim 1, line 7, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube

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#14

In Re Patents

being adapted to be plugged into the wearer's ear --;

Claim 2, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 2, line 4, after "microphone" insert -- and miniature receiver --;

Claim 2, line 4, cancel "an" and insert -- a first --;

Claim 2, line 6, before "tube" insert -- first --; cancel "plastic" and insert -- first --;

Claim 2, line 8, before "tube" insert -- first --;

Claim 2, line 9, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

Claim 3, lines 1 and 2, cancel "employing a miniature microphone of the type used in hearing aids";

Claim 3, line 4, cancel "mechanical microphone" and insert -- diaphragm --

Claim 3, line 5, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 3, line 6, before "tube" insert -- first --;

Claim 4, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 4, line 4, after "microphone" insert -- and miniature receiver --;

Claim 4, line 7, cancel "an" and insert -- a first --;

Claim 4, line 8, before "tube" insert -- first --;

Claim 4, line 9, before "tube" insert -- first --;

Claim 4, line 10, cancel "said tube being proportioned to improve the response of said miniature microphone in the

AO Form 120 (Rev. Oct. 1954)

In Re Patents

United States District Court

portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

Claim 5, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 5, line 4, after "microphone" insert -- and miniature receiver --; cancel "an" and insert -- a first --;

Claim 5, line 6, before "tube" insert -- first --;

Claim 5, line 7, before "tube" insert -- first --;

Claim 5, line 8, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

Claim 6, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 6, line 11, cancel "an" and insert -- a first --;

Claim 6, line 12, before "tube" insert -- first --;

Claim 6, line 13, before "tube" insert -- first --;

Claim 6, line 14, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

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Claim 7, lines 1 and 2, cancel "employing a miniature microphone of the type used in hearding aids" ;

Claim 7, line 4, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 7, line 5, cancel "mechanical microphone" and insert -- diaphragm --;

Claim 7, line 6, before "tube" insert -- first --;

Claim 8, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 8, line 11, cancel "an" and insert -- a first --;

Claim 8, line 12, before "tube" insert -- first --;

Claim 8, line 13, before "tube" insert -- first --;

Claim 8, line 14, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear --;

Claim 9, line 2, cancel "of the type used in hearing aids" and insert -- and a miniature receiver --;

Claim 9, line 11, cancel "an acoustic" and insert -- a first acoustical --;

Claim 9, line 12, before "tube" insert -- first --; cancel "mechanical";

Claim 9, line 17, before "tube", first and second occurrences, insert -- first --;

Claim 9, line 18, cancel "said tube being proportioned to improve the response of said miniature microphone in the portion of the spectrum occupied by the voice frequencies and also to remove objectionable background noise" and insert -- a second

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acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of second tube being adapted to be plugged into the wearer's ear --;

Cancel claim 10.

Add the following claim:

11. A miniaturized microphone headset comprising a miniature microphone with a first acoustical tube connected thereto, and a sound receiver with a second acoustical tube connected thereto.

REMARKS

Claims 1 to 9 have been amended to remove the expressions "of the type used in hearing aids" and "proportioned to improve the response" etc. to which the Examiner objected. The expression "mechanical microphone" has been eliminated and replaced by "diaphragm" in claims 3 and 7.

Some of the claims have been rejected as indefinite in that there is no antecedent for the wearer's eyeglasses. This rejection is respectfully traversed. The wearer's eyeglasses are not a part of the combination claimed, any more than the wearer's ear or the wearer's mouth. Means for gripping the wearer's eyeglasses simply defines the kind of clip used, which clip is part of the combination claimed.

All the claims have been amended to define a headset in which the tranducers are held adjacent to the wearer's ear, and in which <u>two</u> tubes are used, one from the microphone to the mouth and the other from the receiver to the ear. This arrangement is not shown by Dreher who only has one tube, nor by the other art cited by the Examiner. Applicant's claimed device is particularly light and comfortable to wear.

34

Favorable action is solicited.

Respectfully submitted,

[illegible]

By ______________________
Attorney

JJC/cb
8 Dec. [illegible]

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MAIL ROOM
JAN 11 1965
U.S. PATENT OFFICE

IN THE
UNITED STATES PATENT OFFICE

DIVISION 16 ROOM

14810
10
13

RECEIVED
[illegible] 1965
GROUP 230

Wallace Keith Larkin

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25. D. C.

SIR:

SUPPLEMENTAL AMENDMENT

Supplemental to the amendment dated December [illegible], please amend the above-identified patent application as follows:

Cancel claims 1 - 9 and 11.

Add the following claims:

1. ~~12~~. A miniaturized microphone headset employing a miniature microphone and a miniature receiver, comprising the combination of support means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear, a first acoustical tube, means for attaching one end of said first tube to said microphone and the other end of said first tube being adapted to be positioned adjacent to the wearer's mouth, a second acoustical tube, and means for attaching one end of said second tube to said receiver and the other end of said second tube being adapted to be plugged into the wearer's ear.

2. ~~13~~. A miniaturized microphone headset according to claim ~~12~~ 1 wherein said first acoustical tube is made of yieldable plastic material.

3 ~~14~~. A miniaturized microphone headset according to claim ~~12~~ 1 wherein said first acoustical tube is made of polyolefin plastic.

4 ~~15~~. A miniaturized microphone headset according to claim ~~12~~ 1 and adapted for use with a pair of eye glasses wherein the support means include clip means adapted to grip the temple bar of said eye glasses.

5 ~~16~~. A miniaturized microphone headset according to claim ~~12~~ 1 and combined with ~~an oxygen or smoke~~ a mask comprising a chamber mounted in said mask and a diaphragm positioned within said chamber, the end of the first acoustical tube remote from said microphone being acoustically connected to said chamber.

6 ~~17~~. A miniaturized microphone headset employing a miniature microphone and a miniature receiver and combined with ~~an oxygen or smoke~~ a mask, said headset comprising: means for detachably supporting the miniature microphone and the miniature receiver adjacent to the wearer's ear, an acoustical tube, means for attaching one end of said tube to said microphone, a chamber mounted in said mask, a diaphragm mounted within said chamber, and means for acoustically coupling the other end of said tube to said chamber.

B

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REMARKS

Applicant has rewritten the subject matter of claims 1 - 9 into claims 12 - 16 which have been put in dependent form to simplify the issues. Additionally, applicant is presenting claim 17 which is directed to the combination of a single acoustical tube with the diaphragm chamber in the

30

mask. These claims are believed to be purged of the expressions to which the Examiner objected and to be allowable over the art of record.

Faborable action is solicited.

Respectfully submitted,
Wallace Keith Larkin

By J. C. Chognard
Attorney

JCC:cb
7 Jan. 1965

38

MAIL ROOM
JAN
21
1965

IN THE
UNITED STATES PATENT OFFICE

DIVISION 16 ROOM

Wallace Keith Larkin

CASE

SERIAL NO. 158,463

FILED December 11, 1961

SUBJECT MINIATURIZED HEADSET-MICROPHONE ADAPTED FOR USE WITH A MASK

THE COMMISSIONER OF PATENTS,
WASHINGTON 25, D. C.

SIR:

SUPPLEMENTAL SUPPLEMENTAL AMENDMENT

Supplementing the supplement to the amendment dated January 7, 1965, please amend the above-identified patent application as follows:

Claim 16, line 2, cancel "an oxygen or smoke" and insert -- a --;

Claim 17, line 3, cancel "an oxygen or smoke" and insert -- a --.

REMARKS

In accordance with the Examiner's telephone call of January 19, 1965, applicant has removed the objectionable alternative expressions from claims 16 and 17.

Favorable action is solicited.

Respectfully submitted,
Wallace Keith Larkin

By [signature]
Attorney

JCC:cb

20 Jan. 1965

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FORM PO-98
(7-64)

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE

PAPER NO.: 12 14812

SERIAL NO.: 158,463

REFERENCES CITED BY EXAMINER

The following references, cited by the examiner, are of record in the patented file of this patent:

UNITED STATES PATENTS

PATENT NUMBER	DATE	NAME OF PATENTEE	OFFICIAL CLASSIFICATION
2,485,405	10/49	Olney et al.	179-102
2,717,932	9/55	Rackham et al.	179-187
2,904,640	9/59	Dreher et al.	179-156

FOREIGN PATENTS

PATENT NUMBER	DATE	COUNTRY

OTHER REFERENCES

(List the following items when available, page number, date, and title)

40

USCOMM-DC 7031-P64

4546

POL-85
(6-64)

ADDRESS ONLY
THE COMMISSIONER OF PATENTS
WASHINGTON, D. C. 20231

U. S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

NOTICE OF ALLOWANCE

The application for patent identified below has been examined and found allowable for issuance of Letters Patent.

	FILING DATE	SERIAL NO.	NO. OF CLAIMS ALLOWED	EXAMINER	GROUP
	12/11/61	158463	6	R. Rose	23
APPLICANT	Larkin, Wallace Keith; Santa Cruz, Calif.			MAILED Feb. 18, 1965	
ASSIGNEE	Plantronics, Inc.				
TITLE OF INVENTION	Miniature headset-microphone adapted for use with a mask			CLASS-SUB 179/156	

With the allowance of the application the final fee becomes due. This fee is thirty dollars ($30) plus one dollar ($1) for each claim allowed in excess of twenty (20) and must be paid within 6 months from the date of this notice. Failure to remit the final fee will result in the patent being withheld from issue.

As a convenience in remitting this fee, use of the enclosed Form POL-35a is suggested. The final fee will not be received from anyone other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office. If no entry appears in the space labeled "assignee," above, a form is enclosed relating to the address of the inventor(s) which requires your attention.

If it is desired to have the patent issued to an assignee or assignees, an assignment, together with the fee for recording the same, must be filed in this Office on or before the date of payment of the final fee.

The patent will be issued and forwarded within approximately two months after receipt of the final fee.

By direction of the Commissioner.

J. C. Chognard
P. O. Box 406
Palo Alto, Calif.

41

FORM PO-811
(12-64)

U.S. DEPARTMENT OF COMMERCE
PATENT OFFICE
WASHINGTON

14813

Paper No. : 13

Serial No. : 158,463

EXAMINER(S) NAMED IN ALLOWED APPLICATION

The examiners with full or partial signatory authority whose signatures appear upon the actions in this allowed application are named below. Their names shall appear, as given below, on the printed copies of the patent specification and claims as the final matter thereon.

ROBERT H. ROSE	Primary Examiner
WILLIAM C. COOPER	Examiner

42

USCOMM-DC 7822-P64

FOL-85b
(6-64)

6

U.S. Department of Commerce
Patent Office

MAIL ROOM MAR 30 1965

FINAL FEE TRANSMITTAL

This form is provided for convenience in transmitting final fees to the Patent Office. When properly completed it may be used in lieu of a formal transmittal letter. Respondents will note and fill in items numbered 1 thru 5 below. The Final Fee Receipt, in all cases, will be mailed to the address appearing in box at lower left of this form. If desired, use the reverse side of your Notice of Allowance for carbon copy when completing this form.

1. The COMMISSIONER OF PATENTS is requested to apply the accompanying fee to the case identified below, and deliver the patent as indicated.

March 29, 1965 — Date

Jean C. Chognard — Attorney, Agent or Applicant

NOTE—Final fees will not be received from other than the applicant, his assignee, or attorney, or a party in interest as shown by the records of the Patent Office. Final fees will not be applied to pending applications.

	FILING DATE	SERIAL NO.	NO. OF CLAIMS ALLOWED	EXAMINER	GROUP
	12/11/61	158463	6	R. Rose	23
APPLICANT	Larkin, Wallace Keith; Santa Cruz, Calif.			MAILED Feb. 18, 1965	
ASSIGNEE	Plantronics, Inc.			NOTICE OF ALLOWANCE DATE	
TITLE OF INVENTION	Miniature headset-microphone adapted for use with a mask			CLASS-SUB 179/156	

2. Assignee: (If assigned and name does not appear in the corresponding space above)

3. FEE ENCLOSED

30.00

MAILING INSTRUCTIONS

Note—The office will send the patent to the address entered in stub at left below unless you direct otherwise. Use the spaces provided to indicate any changes which affect the delivery of the patent.

4. Do not send the patent to the addressee listed below. Send patent to (check one)

- [ ] Patentee
- [ ] Assignee
- [ ] Associate Attorney (See specific authorization in file)
- [ ] Change of address—Attorney

43

The address of the person checked above is typed in Item 5 below.

5.

H14

AO Form 120 (Rev. Oct. 1954)

In Re Patents

United States District Court
for the

S.D.N.Y.

SOLICITOR

COMMISSIONER OF PATENTS,
Washington 25, D. C. NYC

SIR:

In compliance with the Act of July 19, 1952 (66 Stat. 814; 35 USC 290), you are advised that there was filed on the 20th day of APRIL, 19 72, in this court an action, No. 72 Civ 1625, entitled:

Name PACIFIC PLANTRONICS, Plaintiff,

Address 111 JOSEPHINE STREET, SANTA CRUZ, CALIFORNIA 95060

versus

Name ROANWELL CORPORATION, Defendant,

Address 180 VARICK STREET, N.Y.C. N.Y.

brought upon the following patents:

PATENT NO.	DATE OF PATENT	PATENTEE
1. 3,184,556	MAY 18th, 1965	PLFF
2. DES. 218,173	JULY 28th, 1970	PLFF.
3. 3,548,118	DEC 15th,1970	PLFF.
4.		
5.		

In the above-entitled case, on the day of , 19 , the following patents have been included by (insert amendment, answer, cross bill, or other pleading):

PATENT NO.	DATE OF PATENT	PATENTEE
1.		
2.		
3.		
4.		
5.		

In the above-entitled case the following decision has been rendered or judgment issued:

JOHN LIVINGSTON,
Clerk.

Date APRIL 21, 19 72

By JAMES L. NUGENT.
Deputy Clerk.

AO Form 120 (Rev. Oct. 1954)

In Re Patents

United States District Court
for the
Western District of Michigan,

SOLICITOR
JAN 2 1974
U.S. PATENT OFFICE

#15

COMMISSIONER OF PATENTS,
Washington 25, D. C.

SIR:

In compliance with the Act of July 19, 1952 (66 Stat. 814; 35 USC 290), you are advised that there was filed on the 14th day of December, 1973, in this court an action, No. K152-73CA 8, entitled:

Name Plantronics, Inc., Plaintiff,
Address 111 Josephine St., Santa Cruz, California

versus

Name Electro-Voice, Inc., Defendant,
Address Carroll & Cecil Sts., Buchanan, Michigan

brought upon the following patents:

	PATENT NO.	DATE OF PATENT	PATENTEE
1	3,184,556	5-18-65	Plantronics, Inc.
2			
3			
4			
5			

In the above-entitled case, on the day of , 19 , the following patents have been included by (insert amendment, answer, cross bill, or other pleading):

	PATENT NO.	DATE OF PATENT	PATENTEE
1			
2			
3			
4			
5			

In the above-entitled case the following decision has been rendered or judgment issued:

....,
Clerk.

Date ...., 19...... By ....,
Deputy Clerk.

38

m PO-436

158463

SERIAL NO. (Series of 1960)

Assistant examiner

Coope

GROUP 10

Applicant(s)

SEARCHED

Class	Sub	Date	Ex'r
179	156 187	[illegible]	[illegible]

INTERFERENCE SEARCHED

CLASS	SUB.	DATE	EX'R
179	156 188-8	JAN 28 1965	[illegible]

INDEX OF CLAIMS

Final	Original	JAN 28 1965	Final	Original
	1	✓		61
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	3	✓		63
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	5	✓		65
	6	✓		66
	7	✓		67
	8	✓		68
	9	✓		69
	10	✓		70
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	59			119
	60			120

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SYMBOLS	STATUS
✓	Rejected
=	Allowed
– (Through numeral)	Canceled
+	Restriction requirement
N	Nonelected invention or species
I	Interference

PLAINTIFF'S

1-15-02

CONTENTS

1. Application ✓ papers. 26.
2. Prints Dec. 27/61 27.
3. Rev. & P/atty (NE) Sept-11-62 28.
3a. Title Report Feb 1-63 29.
5. Letter re: P/atty Feb-8-63 30.
6. Rev. & P/atty. by Assign. - Apr. 2, 1963 31.
7. NOTICE OF REV. & ACCEPT. APR 9 1963 32.
8. REJECTION JUN 11 1963 33.
9. Amdt. A Dec. 9, 1963 34.
10. Amdt B Jan 11/64 35.
11. Amdt C Jan 21/1965 36.
12. LIST OF REFERENCES 1-29 37.
13. List of Exrs. Names 38.
14. Notice of Suit April 20, 1972 39.
15. Notice of Suit December 14, 1973 40.
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16—11375-7 U. S. GOVERNMENT PRINTING OFFICE

PLAINTIFF'S

II. MS-43

POST AURICULAR MOUNTED HEADSET

During March 2, 1962, Plantronics finalized the conceptual design stage of their model MS43 Ear-Supported microphone-receiver. Because of the intensive effort being made at that time to perfect their Model MS50 unit for United Air Lines, it was decided to "farm out" the physical design stage and prototype production to Audiotone in Phoenix, Arizona, a division of Royal Industries, Inc., with proprietary rights remaining with Plantronics.

This device was a mating of the acoustic-tube microphone and an Audiotone hearing aid. The device was to be worn in normal hearing aid fashion with the transducers and a small transistorized amplifier mounted in a small pod located just behind the user's ear. This pod was held in place by an ear tube which protruded from its uppermost surface and curved around the

POST AURICULAR MOUNTED HEADSET

top of the ear and terminated in a soft plastic ear insert. The microphone transducer was mounted in the bottom of the pod and an acoustic tube lead from that point to the corner of the user's mouth.

Several versions of this device were planned, including a wireless version designed to offer the user complete mobility and freedom of movement. After the prototype stage was completed in the fall of 1962, several user evaluations were undertaken in the Santa Cruz area.

Although the MS45 offered many advantages in the area of weight reduction and in the incorporation of the matching amplifier into the device itself, the method of mounting to the user proved to be less than adequate. Swift lateral motions on the part of the user produced inertial drag and sway on the part of the headset which tended to move the acoustical tube out of

position with the result that transmission tended to be "spotty". Some of the test subjects did not have adequate clearance between the ear and their head to accomodate the pod. Others' ears were so configured that the ear insert would not stay in place.

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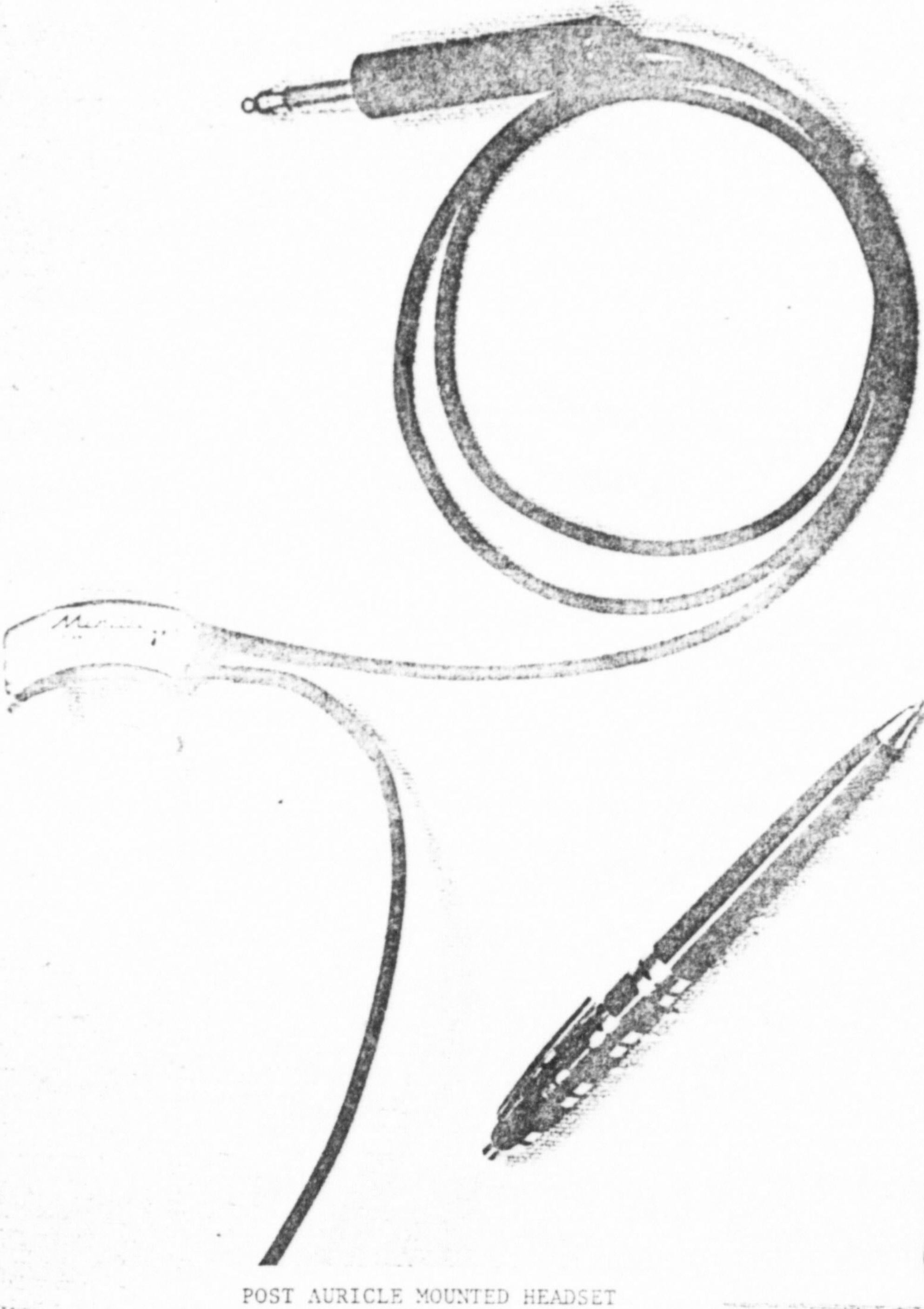

POST AURICLE MOUNTED HEADSET
DEVELOPED MARCH 1962. REFERRED
TO AS MS43 MODEL

275

EP 4805

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MS43 POST AURICLE TYPE HEADSET
USED IN SWITCHBOARD SERVICE
EVALUATION

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SELF-SUPPORTING OPERATOR'S HEADSET

Filed Sept. 11, 1963 2 Sheets-Sheet 1

FIG. 1

FIG. 2

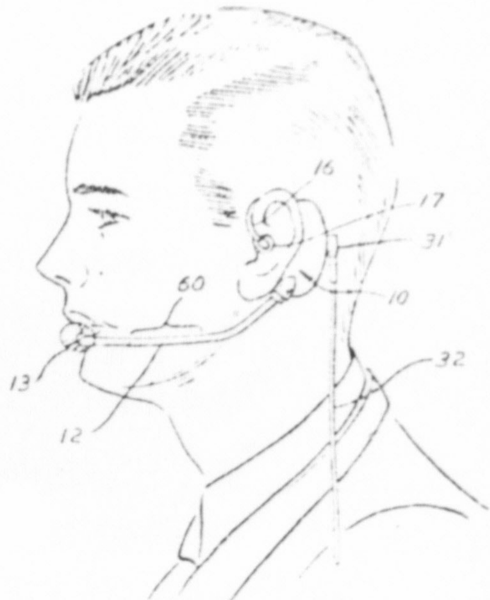
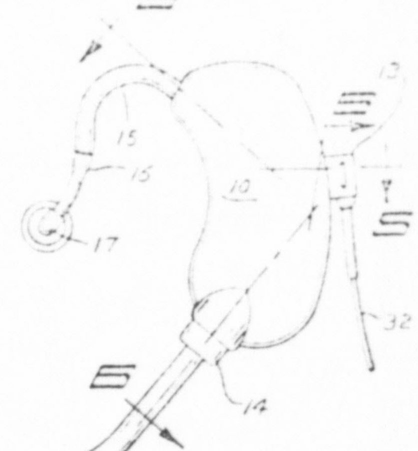


FIG. 3



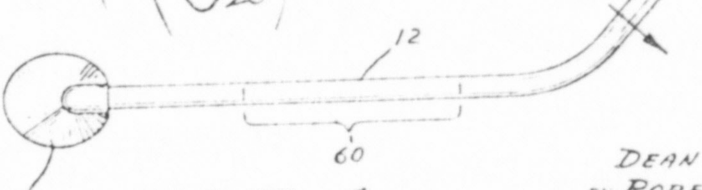


FIG. 4

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Ex. 67 277

A-24546

Oct. 18, 1966 D. W. FLYGSTAD ETAL 3,280,273

SELF-SUPPORTING OPERATOR'S HEADSET

Filed Sept. 11, 1963 2 Sheets-Sheet 2

FIG. 7

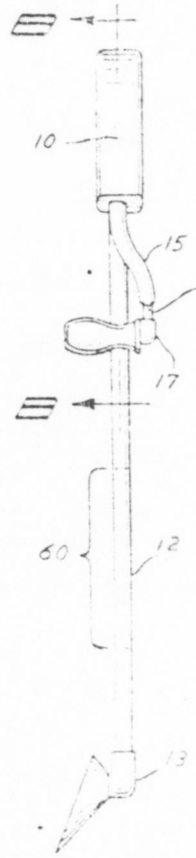


FIG. 5

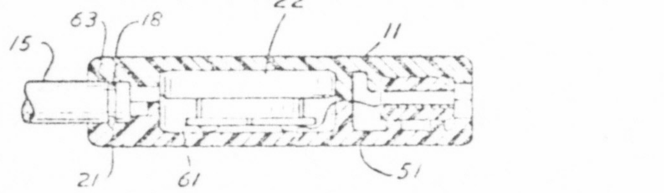
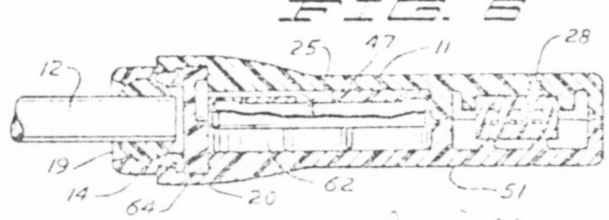


FIG. 6



Receiver

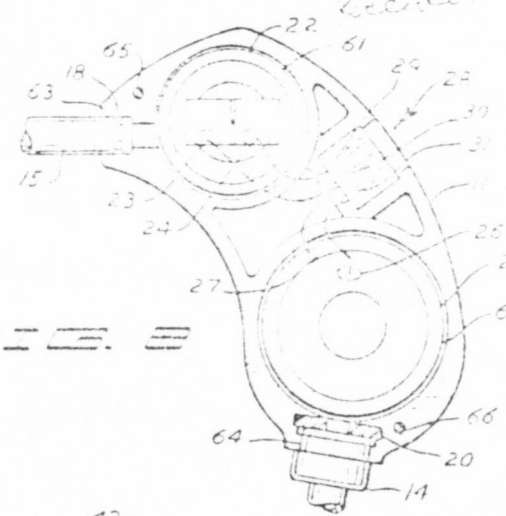


FIG. 8

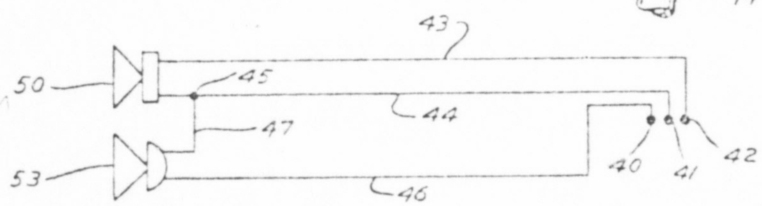


FIG. 9

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278

United States Patent Office

3,280,273

Patented Oct. 18, 1966

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3,280,273

SELF-SUPPORTING OPERATOR'S HEADSET

Dean W. Flygstad, Roseville, and Robert L. Sell, Minneapolis, Minn., assignors to The Telex Corporation, Tulsa, Okla., a corporation of Delaware

Filed Sept. 11, 1963, Ser. No. 308,240
8 Claims. (Cl. 179—156)

This invention relates generally to two-way communication apparatus and is more particularly related to apparatus containing a receiver and a microphone that is intended to be worn by an operator.

In the prior art with which this invention is concerned, much effort has been directed to provide lightweight, comfortable and efficient headsets to be used, for example, by telephone operators. One common feature found in the prior art is an intermediate supporting structure to hold a receiver in sound transmitting relationship with an operator's ear and a microphone in sound receiving relationship with an operator's mouth. One recent example of such supporting structure is a headband which extends up and across a substantial portion of the top of an operator's head. Another example supports the necessary apparatus on the bow, or templet member, of a pair of eyeglasses. In still another example, a receiver may be supported on a headband and a microphone may be supported in structure adapted to be suspended around the operator's neck. These and other examples of the prior art may be found lacking in one or more of the desirable features noted above.

In our invention, we have provided a novel and useful improvement in providing a self-supporting headset. Briefly, our apparatus includes a housing that has depending sound conducting [illegible] supporting and stabilizing the headset on the head of an operator, and a suitably mounted receiver and microphone, all of which coact to provide a combination of elements that is lightweight, comfortable and efficient.

It is therefore an object of our invention to provide a novel operator's headset.

It is a further object of our invention to provide a self-supporting operator's headset.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

FIGS. 1–3 illustrate a preferred embodiment in position on an operator's head.

FIG. 4 is a side elevational view of the preferred embodiment of our invention.

FIG. 5 is a sectional view taken along section lines 5—5 in FIG. 4.

FIG. 6 is a sectional view taken along section lines 6—6 in FIG. 4.

FIG. 7 is a plan view of the preferred embodiment of our invention.

FIG. 8 is a sectional view taken along section lines 8—8 in FIG. 7.

FIG. 9 is an illustrative electrical schematic drawing of the electrical portion of our invention.

Referring now to the drawings in which like reference numerals have been applied to like elements of our invention, there is shown a self-supporting operator's headset comprised of a housing 10 which may contain a receiver 22 and a microphone 25 that are appropriately positioned to coact with a forwardly extending tube member 15 and a second forwardly extending tube member 12. Tube member 15 is in turn connected to a further tube member 16 that is adapted to carry an ear insert 17. Tube member 12 is mounted in a ball 19 and socket 14 and extends forwardly from the lower end of housing 10 and carries at its forward end a megaphone 13. Tube 12 is adapted to engage the cheek of an operator at a point or points along its length as indicated by bracket 60.

2

As will be apparent from the drawings, housing 10 is comprised of a pair of substantially identical members 11 and 51 which, when suitably disposed, combine and coact to define a pair of acoustically independent transducer mounting chambers 61 and 62 at opposite ends of the assembled housing 10. A further chamber is provided intermediate the acoustically independent chambers for mounting a three-terminal jack, indicated generally by the reference character 28.

Chamber 61 is adapted to receive and hold a receiver 22 having a pair of input terminals 23 and 24 that are connected through suitable conducting means to a further pair of terminals 29 and 30 on jack member 28. Chamber 61 also includes a forwardly extending aperture 63 which is adapted to receive the end of tube member 15.

Chamber 62 is adapted to receive and mount a microphone 25 which is provided with a pair of output terminals 26 and 27 that are connected through suitable conductors to terminals 30 and 31 on jack member 28. Chamber 62 also includes a generally forwardly extending aperture 64 for receiving socket 14 and sound baffling member 20. A further sound baffling member 47 is shown positioned at the bottom of chamber 62 on member 11. Sound baffling member 20 includes a first slot extending completely through and a second groove extending partly through member 20 to define an opening which is adapted to coact with a radially extending channel on the lower surface of baffling and [illegible] 47 [illegible] phone 25.

Member 11 [illegible] 65 and 66 [illegible] 51 [illegible] 11 and 51 [illegible] 11 and 51 [illegible] to form housing 10 [illegible] receiver 22, microphone 25, baffles 47 and 20 and jack 28 are positioned and suitably interconnected and may be cemented together through the use of any suitable adhesive which will provide the desirable acoustical insulating properties to ensure acoustical isolation between chambers 61 and 62.

Tube 15, which may be comprised of any suitable semi-rigid plastic material, is provided with a groove 18 which may coact with a pin member 21 mounted in member 51 so as to allow rotation of tube member 15 in aperture 63. Tube member 15 is, in turn, connected to a further tube member 16, which may be of a pliable material. An earplug 17 is shown mounted on the end of tube 16 and may be of suitable shape and compliancy to be comfortably inserted in the auditory canal of an operator.

Tube member 12 is held in ball 19 through the use of a suitable adhesive. Ball member 19 is in turn rotatably journaled in a socket 14 which is in turn positioned and held in aperture 64 at the lower end of housing 10. Tube member 12 may also be comprised of a s[illegible] plastic material and has mounted at its forw[illegible] end a megaphone 13 that is adapted to receive sound [illegible] the mouth of an operator and may be of any suitable s[illegible] and shape.

In FIG. 4 of the drawing a suitable three-conductor plug member 31 is shown in position on jack 28 and is in turn connected to a suitable cable 32 that may be connected to suitable communication equipment which includes a source of signal and signal utilization means.

In FIG. 9 an electrical schematic representative of circuitry that may be employed with our invention is shown. A three-terminal plug represented generally by

reference characters 40, 41 and 42 is shown connected in circuit with a microphone 53 and a receiver 50, each of which has a pair of terminals. One of the terminals on receiver 50 is connected to terminal 41 through conductor 44 and is also connected to one of the terminals on microphone 53 through terminal 45 on conductor 44 and conductor 47. The other terminal on receiver 50 is connected to terminal 42 through conductor 43. The second terminal on microphone 53 is connected to terminal 40 through conductor 46.

It may thus be seen that our invention broadly includes a housing 10 which may have a first forwardly extending tube member 15 and a second forwardly extending tube member 12 and a jack 28 for connection to suitable communications equipment through cable 32.

Referring now to FIGS. 1, 2 and 3, our invention is shown in position on the head of an operator. Housing 10 is positioned directly behind the ear of the operator and tube member 15 extends forwardly to lie on the top of the ear and thence downwardly to provide a coupling to the auditory canal of the operator. Tube member 12 extends forwardly into engagement with the cheek of the operator along the area indicated by reference numeral 60 and the megaphone 13 is positioned in proximity to the mouth of the operator in a position which will provide for the most efficient transfer of intelligible sound energy from the particular operator using our apparatus.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described our invention, what we claim to be new and desire to protect by Letters Patent is:

1. An operator's headset comprised of an elongated hollow housing containing a receiver and a microphone, said housing being shaped to lie behind the ear of an operator, said housing [illegible] extending forwardly [illegible] the ear [illegible] and into proximity of the auditory canal, said housing also having a tubular [illegible] extending [illegible] its lower end into contact with the face of the operator and into proximity of the mouth of the operator whereby the housing is supported [illegible] the ear and face of the operator.

2. An operator's headset comprising a housing having a portion adapted to engage the back of the ear of an operator, said housing being vertically elongated and having separate chambers in proximity to the top and bottom ends thereof, each of said chambers having an aperture extending generally forwardly thereof; a microphone in the bottom chamber; a receiver in the top chamber; a tube extending forwardly of the aperture in said top chamber to lie on top of the ear and downwardly to extend into the auditory canal of an operator; a further tube extending generally forwardly of the aperture in said bottom chamber, said tube being adapted to lie on the cheek and extend into proximity of the mouth of an operator.

3. The apparatus of claim 2 in which the further tube is pivotally mounted in the aperture in said bottom chamber.

4. The apparatus of claim 3 in which the tube extending from the top chamber is rotatably journaled in the aperture.

5. The apparatus of claim 2 in which first and second resilient gaskets, each having sound energy transmitting channels and apertures, coact to provide a conduit for the transmission of sound from the aperture on the bottom end of the housing to the diaphragm of the microphone mounted therein.

6. An operator's headset comprising in combination: a hollow housing including terminal means for connection to a source of signal and a signal utilization means, said housing being of generally arcuate shape to lie behind and engage the ear of an operator; a first forwardly and downwardly extending tube member at the top of said housing, said tube member being adapted to engage the ear of an operator along a portion of its length and cooperating therewith to support the housing on said ear; sound receiving means electrically associated with said terminal means, and associated with said tube member to supply sound energy to the auditory canal of an operator; a second forwardly extending tube member at the bottom of said housing, said tube member being adapted to engage the side of the face of an operator and having an opening adapted to be positioned in sound receiving relationship to the mouth of an operator; and microphone means electrically associated with said terminal means and associated with said second tube member to receive sound energy from the mouth of an operator.

7. An operator's headset comprised of a housing member adapted to abut the rear portion of an operator's ear, a forwardly extending tube member adapted to extend over the top of an operator's ear, a further tube member extending forwardly into proximity with the mouth of [illegible] with the cheek of [illegible] set on the ear of an operator.

8. [illegible] comprising in combination [illegible] microphone and receiver, a hollow housing including forwardly extending sound conducting members, one of said members being adapted to engage the [illegible] of the ear of [illegible] sound energy to said ear and the other of said [illegible] extending into proximity of the mouth of an operator and being adapted to engage the cheek of an operator whereby said hollow housing is supported only by said sound conducting members; and means mounting said microphone and said receiver in said housing in acoustically independent relationship so that said one member provides sound energy to the ear of an operator and said further member receives sound energy from the mouth of the operator.

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KATHLEEN H. CLAFFY, *Primary Examiner.*

WILLIAM C. COOPER, *Examiner.*

280

Sketch 1

PLAINTIFF'S EXHIBIT 68

Miniature transducers and modern electronics have been combined to give the Bell System two new lightweight telephone headsets to be used by operators. Both kinds of headsets are designed for comfort and have improved transmission performance.

Telephone Headsets With a New Look

J. L. Peterson

IN THE NEWLY DECORATED OFFICES housing the traffic service position system (TSPS), the bulky 52-type operator headsets appear as much out of place with the carpeting and soft lighting as the old breastplate headsets used at the turn of the century. Modern times call for modern designs and as the attractive TSPS consoles replace the old cord switchboards, new lightweight headsets are also replacing the old 52-type sets. The Bell System has introduced two new lightweight headsets, called 60A and 61A, to fulfill the needs of telephone operators today.

The 61A is a personalized headset very small in size. An ear insert, which couples the receiver to the ear, is custom-molded to fit the ear of each operator and to support the headset. And since it no longer uses a headband, the new headset doesn't rumple the hair when the operator takes it off and puts it on. The operator talks through an adjustable, transparent tube, which directs the voice to a miniature transmitter located in the ear capsule. A cord connects the ear capsule to a plug containing a transmitting amplifier. Attached to the cord is an adjustable lanyard that protects the operator against any jolts on the cord or forces being transmitted to the ear.

Since custom-molded ear inserts add an expense to headsets that might not be justified for short-term employees, a second headset, 60A, was designed. This headset employs an ear capsule, about the same size as the one on the 52-type headset, that is held onto the ear by a lightweight spring headband. The ear capsule contains a new receiver a little more than 1½ inches in diameter and the same miniature transmitter used in the 61A headset. Other features of the 60A headset are identical to the 61A.

Bell Labs began developing these headsets at

Ex. 68
EP10928
F1121
281

Sketch 2

Sketch 3

Holmdel, N. J., in 1963, by investigating various possible lightweight designs. Four designs were finally chosen for field trial in 1965. Results showed that operators preferred sets similar to the 60- and 61-type sets over all other types of headsets. Work then began on components that would meet the requirements of the Bell System for transmission performance and reliability.

The development included a new miniature transmitter, a miniature and regular-size receiver unit, two ear capsules, two amplifier housings, and an amplifier. The ear capsule in the 61A headset contains a transmitter and receiver unit packaged in a sealed plastic case. The physical design of this receiver and transmitter capsule was particularly important since mechanical, magnetic, and acoustic coupling could affect the performance. If coupling is too great, a high-pitched tone may develop, which will be heard by both the operator and the person to whom she is talking. Unwanted acoustic coupling is removed by mounting the transmitter and receiver units in separately sealed compartments.

Susan J. Kaplan of Bell Labs, Murray Hill, N. J., demonstrates two new operator headsets designed at the Indianapolis location. The 60A set (top) has an ear capsule about the same size as the one on the older 52-type model, and is held onto the ear by a lightweight spring headband. The second headset, 61A (right), is yet smaller in size and is worn without a headband. A cord (below) connects the ear capsule to a plug containing a transmitting amplifier. Attached to the cord is an adjustable lanyard that is worn around the neck.

EP 10959
F 1122

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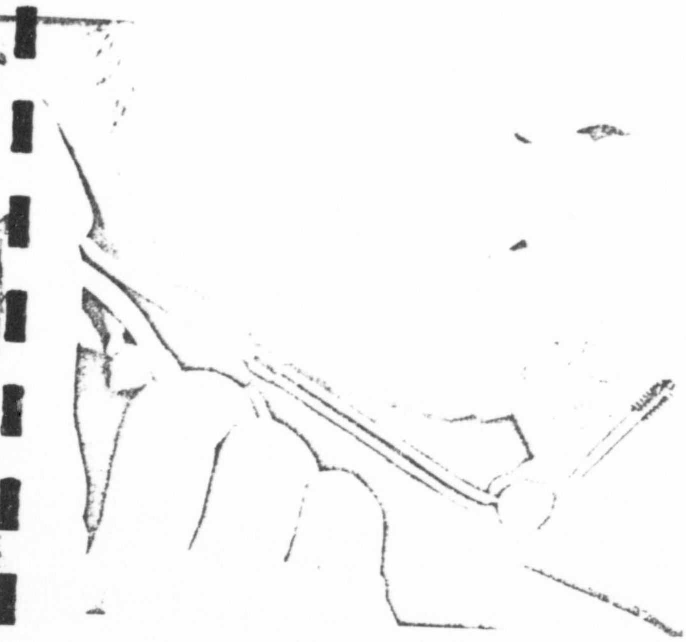
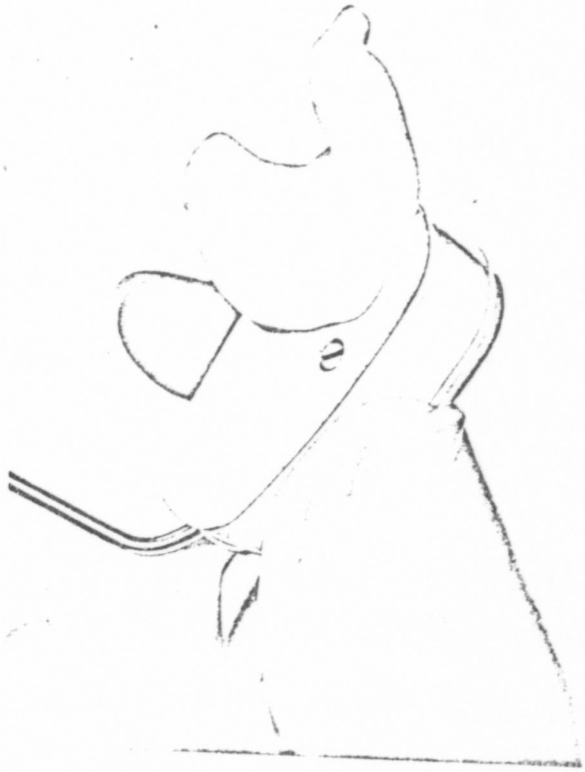
Sketch #3





The operator adjusts a transparent tube (above), through which the voice is sent to a miniature transmitter located in the ear capsule. The ear insert (right) is custom-molded to fit the ear of the operator. Silicone rubber kits are supplied to allow each office to produce custom earmolds as required. The earpiece is soft and flexible and can be used several hours after molding.

Attached to an opening in the transmitter compartment is the speech-tube assembly. The assembly comprises a metal tube with a ball joint and a plastic tube, which slides along the metal tube. Thus, the length and angle of the speech tube can be quickly adjusted. The end of the plastic tube contains a porous metal disc for absorbing acoustic resonance in the tube and a wound-wire tip that softens harsh sounds generated from words starting with explosive sounds such as the letter "p".

The cord is attached to the ear capsule through a connector on the end of the cord and contact springs on the capsule. The custom-molded ear insert is attached by a snap which also serves as the sound port to the receiver compartment.

The ear capsule of the 60A headset is similar in shape to that of the 52-type headsets except it has been elongated slightly to hold the miniature transmitter and receiver units. The transmitter is carefully mounted to eliminate coupling from the receiver unit and is attached to a speech-tube assembly identical to that of the 61A headset. Unlike the 61A headset, which is inserted into the ear, the ear capsule of the 60A headset is held against the ear by a new lightweight headband which is attached by a yoke-and-gimbal assembly in such a way that the capsule can pivot and rotate for proper fit.

The new miniature transmitter and receiver units differ only in the design of the coil and acoustic chamber in back of the diaphragm. Both units are about 0.5 inch in diameter and 0.2 inch thick. Known as electromagnetic transducers, these units convert acoustic signals to electrical signals and vice versa. An electrical signal is generated by the coil when the diaphragm is energized by an acoustic signal and, conversely, an acoustic signal is generated by the diaphragm when an electrical signal is applied to the coil. The transducers have a rugged design so that they will operate reliably for many years.

The transmission characteristics are such as to produce intelligible and natural speech. Frequency response is similar to that of a normal customer telephone, except that distortion has been reduced to a minimum. The overall transmission characteristics of the headset are governed by the speech

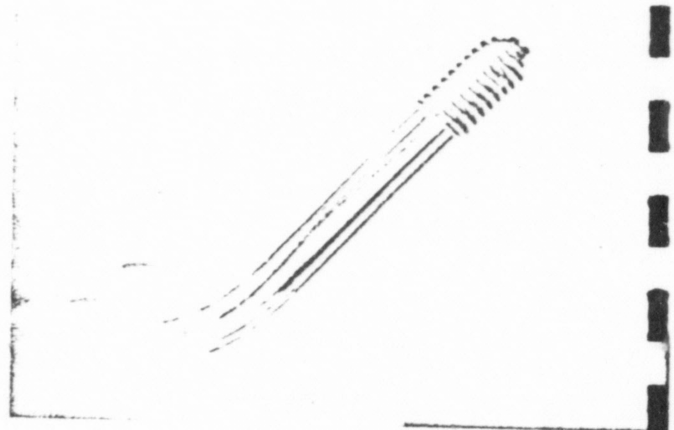
283 EP10,930 F1123

tube, transmitter, amplifier, and sidetone circuit. The transmitter characterizes the general shape of the frequency response, the speech tube amplifies low frequencies, and the amplifier filters out low and high frequencies while also boosting low frequencies. The transmission response therefore has a smoother, more desirable shape than that of other headsets.

The headset amplifier adds about 45 dB or 55 dB of gain to the transmission path and operates over a wide range of voltages and currents. This type of dual-gain amplifier was necessary because the efficiency of the carbon transmitter used in 52-type headsets varies with the amount of available current. Although the operator telephone circuits used in central offices and at some larger PBX locations have a local battery supply that provides adequate current for good transmission levels, the available current is severely limited on most PBX consoles and all jack-equipped station sets by other circuits. In these circuits, the output of the 52-type headset is about 10 dB below the desired levels. To correct this difference, amplifiers with 10 dB of gain have been added to all PBX consoles and jack-equipped station sets. Thus, for the lightweight headsets to work interchangeably with 52-type headsets, their output levels had to be lowered by 10 dB. This adjustment in level is done automatically by a circuit in the headset amplifier which detects the amount of current available from the operator or telephone circuit and changes the amplifier gain appropriately. Thus, correct transmission levels are always maintained so additional adjustments are unnecessary.

Another requirement that added to the complexity of the amplifier was the need to attenuate low-level input signals, such as background noise and speech from operators working nearby. Although this attenuation is inherent to a small degree in the 52-type headsets due to the nonlinear characteristics of the carbon transmitter and its tendency to reduce weak signals, such characteristics are not exhibited by electromagnetic transmitters. Instead, a circuit was added to the new headset to attenuate signals in the amplifier when sound pressure drops below a predetermined level.

The receivers in the new headset generate acoustic output levels comparable to normal telephones and about 2 dB greater than the 52-type headsets. The frequency response of the lightweight headsets has also been improved over the old headsets by cutting off low-frequency noise from the line. In addition, the high-frequency audio output in the 61A telephone headset has been increased to simulate the normal amplification that takes place in the auditory canal of the ear,



The speech-tube assembly comprises a metal tube with a ball joint and a plastic tube, which slides along the metal tube. The end of the plastic tube contains a porous metal disc for absorbing acoustic resonance and a wire tip that softens harsh sounds.

which is eliminated by the earmold.

Germanium varistors are used with the receiver units of both the 60A and 61A headsets to protect the operator's ear from high acoustic pressures. These varistors, connected in parallel with the receiver unit, break down or short circuit at voltages such that outputs from the receiver never exceed 120 dB.

The new receiver unit in the 60A headset is designed to replace all other Bell System receiver units in the future. The design of the receiver—a bipolar, electromagnetic unit—is the result of a joint effort by Western Electric and Bell Laboratories to develop an efficient and universal unit which can be produced economically by automated equipment. The first units were installed in the 60A headset. They are also currently being used in 52-type headsets as well as in other telephone apparatus, such as the TRIMLINE®, telephone headset.

The lightweight headsets form a new family of units compatible with present plant equipment and signal levels and at the same time with improved transmission characteristics. The sets have been widely accepted by operators because they are light in weight and can be worn for long periods of time comfortably.

284 EP10, 33
F1124

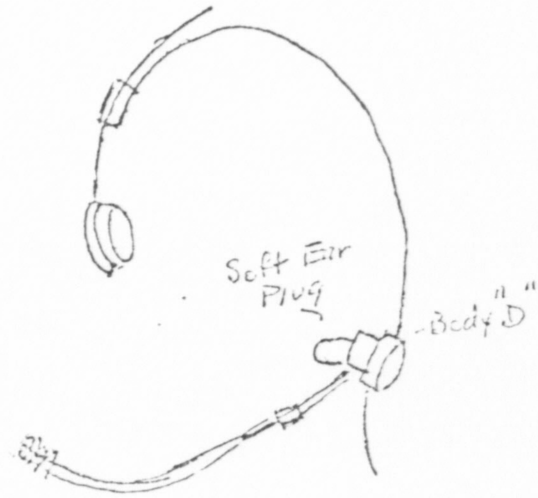
Question -- Method desired for

BELL TELEPHONE LABORATORIES'

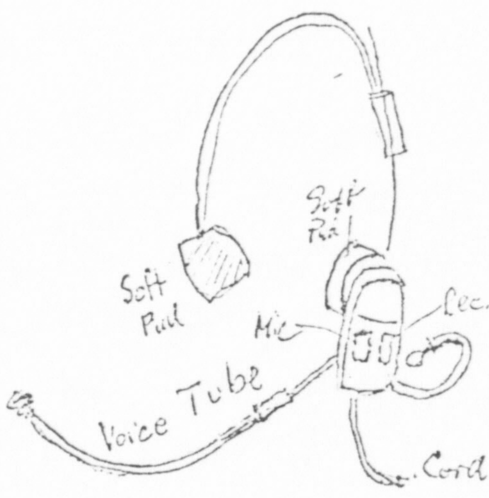
MODELS A, B, C, D

MODEL A

MODEL B



MODEL C



MODEL D

Ex. 69 285

Sketch #6

Question -- Method desired for

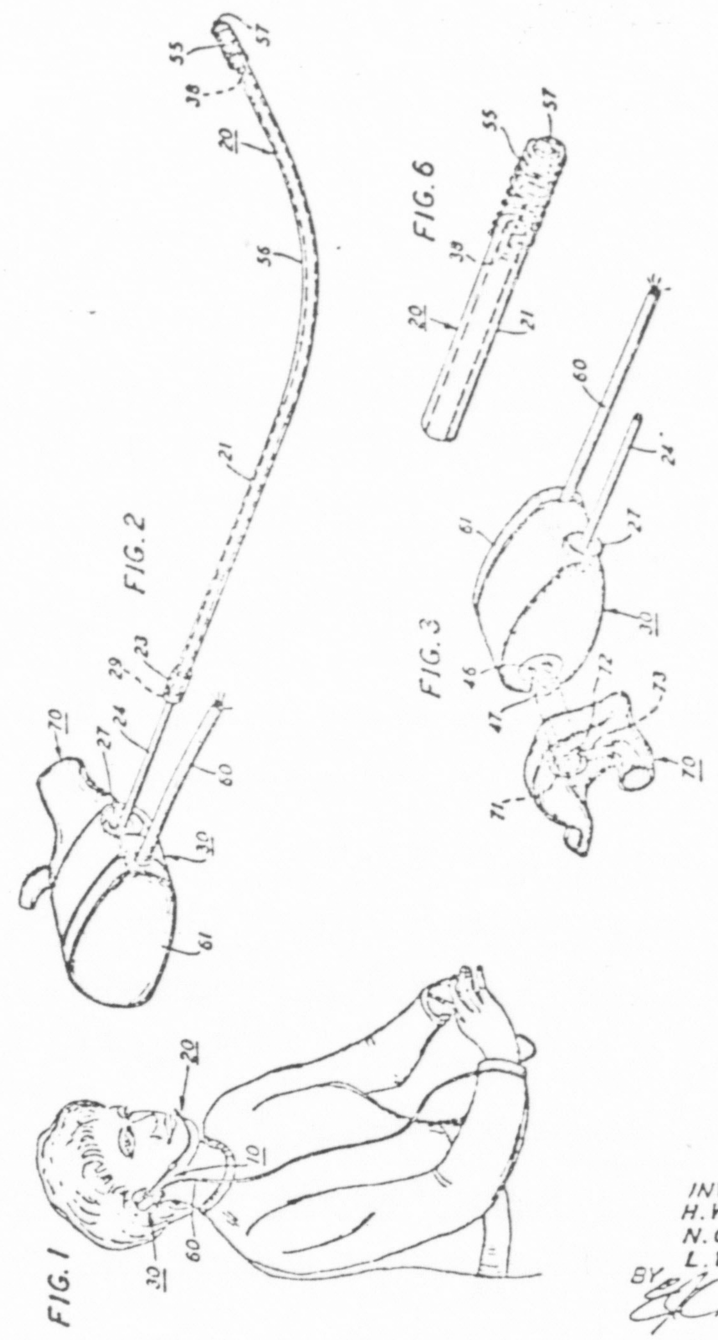
Sketch # 7

PLAINTIFF'S EXHIBIT 10

April 22, 1969 H. W. BRYANT ET AL 3,440,365

TELEPHONE HEADSET WITH ADJUSTABLE SPEECH TU[illegible]

Filed Nov. 4, 1965 Sheet 1 of 2



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ATTORNEY

Ex. 70 286

Sketch # 7

April 22, 1969 H. W. BRYANT ET AL 3,440,365

TELEPHONE HEADSET WITH ADJUSTABLE SPEECH TUBE

Filed Nov. 4, 1965 Sheet 2 of 2

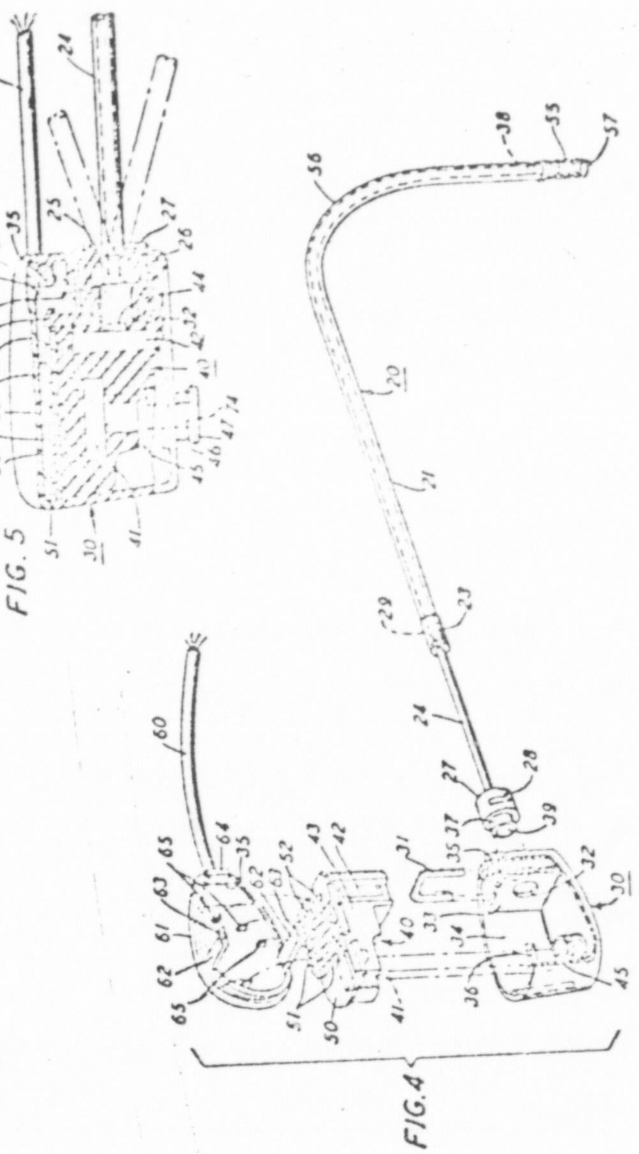

FIG. 5

FIG. 4

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United States Patent Office

3,440,365
Patented Apr. 22, 1969

3,440,365

TELEPHONE HEADSET WITH ADJUSTABLE SPEECH TUBE

Herbert W. Bryant, Middletown, Norman C. Hazell, Freehold, and Lionel W. Mosing, Springfield, N.J., assignors to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Filed Nov. 4, 1965, Ser. No. 506,310
Int. Cl. H04m 1/05
U.S. Cl. 179—156 6 Claims

ABSTRACT OF THE DISCLOSURE

A telephone headset is disclosed consisting of a housing, containing the transmitter and receiver, a two piece speech tube connected to the housing, and an acoustic ear insert on which the housing is mounted. The housing can rotate on the ear insert, the fitting permitting this also constituting a part of the acoustic passage between the inner ear and the receiver. The inner portion of the speech tube is rigid and swivelably mounted to the housing. The outer piece is curved and also slidable and turnable with respect to the inner portion. The geometry allows adjustment of the headset to almost any wearer's head configuration.

This invention relates to transmitter-receiver units of the type supported during use upon the head of the user, and, in particular, to headsets worn by telephone operators.

An increasing concern for operator comfort as well as equipment performance has prompted much recent effort to improve radio and telephone headsets. Broadly, the two prime causes of wearer discomfort are the weight and bulk of the set, and the distribution of whatever weight is involved. Significant weight and size reductions are achieved by replacing the heavy magnetic core receivers and carbon-type transmitters with miniature balanced armature transducers of the type routinely used in hearing aid devices. These transducers operate advantageously in conjunction with acoustic pick-up tubes, and this expedient has also been employed in the telephone headset art to reduce weight.

However, several facets of the weight distribution problem have not been solved satisfactorily. Moreover, other important and persistent problems, including pick-up tube positioning limitations and the manner of support for the whole headset, require better solutions, preferably ones which in fact further reduce the weight distribution problem instead of complicating it.

One of the problems relates to headbands per se, which are necessary with most headset designs to provide the needed support. Headbands are inherently bulky, add to the headset's cost, and must be maintained and stored. For some applications as, for example, when other heavy headgear must also be worn, headbands are frequently inconvenient or unsuitable. Moreover, to a large number of hairdress-conscious women operators, headbands of any type are anathema because of their bulk and tendency to snag and disturb the hair. One typical substitute for the headband is a supportive lanyard, but these lend only loose support and consequently the set is not held stably in the required position. Other methods of avoiding headband support include suspending the set from a loop placed around the ear, similar to eyeglass frames, or suspending the set from the eyeglass frame itself. The eyeglass clip method, however, tends to shift the optical axis, and is limited in any case to persons who wear glasses. The over-ear loop lacks stability and also disturbs the optical axis if glasses are also worn.

Another general problem involves the support or suspension mechanisms for positioning the headset in accordance with the wearer's mouth-ear geometry. One aspect is that conventional supports incorporated in headset designs in an effort to make the set adaptable to widely varying head geometry and wearing preferences, employ very complicated and bulky adjustment features. Simplified support designs have sacrificed at least to some extent the adjustability. Further, earlier support designs do not take into account adequately certain wearer preferences, particularly of telephone operators, which include location of the supportive pressure, manner of putting on and removing the set and movement of the transmitter independently of the receiver.

A related problem is that the positions in which operators are willing, or tend, to wear a given headset do not coincide necessarily with the position in which the set performs best. To treat this problem and the preceding ones simultaneously, requires acoustic refinements not found in prior art devices.

A further problem, principally one of acoustics but bearing importantly on operator comfort, relates to the receiver-to-ear seal. Tight seals are desirable from the transmission standpoint, but are achieved in today's headsets with considerable sacrifice in operator comfort.

Another drawback of headsets using acoustic pick-up tubes relates to the effects created under certain circumstances by operator speech sounds such as *b* and *p*. The operator's breath which produces these sounds is a strong puff that impinges full-force upon the tube entrance normally maintained about three-fourths of an inch in front of the mouth. The sidetone this creates is audible to operator and calling party and at high levels is unpleasant and distracting to both. The effect is minimal if, as with sets having conventional size earcaps, there are sufficient sound leakage losses inherently present in the set. However, the problem becomes acute if a receiver of high efficiency is employed. In such case the sidetone effects of *b* and *p* sounds compel the operator to place the tube entrance farther from the mouth or to use a reduced speech level. Either action weakens the transmission level and makes reception of operator speech by the calling party difficult.

Accordingly, a general object of the invention is to reduce substantially the degree of discomfort incident to wearing a telephone headset.

Another object of the invention is to improve the acoustic performance of telephone headsets.

A further object of the invention is to simplify the positionability of the several elements in a typical operator's headset.

A further object of the invention is to reduce the absolute number of elements necessary in a headset.

A still further object of the invention is to eliminate the unpleasant sidetone effects caused by puff sounds in a headset using an acoustic pick-up tube.

These and other objects are accomplished in accordance with the invention in a telephone headset in which a single, compact housing, containing the transducers

and all connections and supporting a widely adjustable acoustic pick-up tube, is suspended from an acoustic earpiece inserted in the operator's ear.

In one embodiment of the invention, the housing is rotatably mounted on the earpiece. The speech tube is mounted in a ball-joint within the housing to permit adjustments in a large circular arc. Further rotative and longitudinal adjustments are achieved with a slide feature. The headset cord connector is integral with the cap to the housing, which reduces bulk and weight and facilitates cord replacement. The housing, speech tube and cord are thus placed well out of the operator's line of vision and away from her work area.

Advantageously, the plastic ear insert is molded to fit the particular ear geometry of the user. This expedient, well known in the hearing headset art, achieves not only the expected superior receiver-to-ear seal, but because of its snug fit provides a point of suspension for the headset proper that is secure, stable and surprisingly comfortable.

In accordance with another aspect of the invention, a puff screen is mounted at the entrance to the acoustic pick-up tube to reduce the sidetone effects caused principally by the sounds of *b* and *p*. The screen is an extended coil spring with inwardly-extending helical end portion and, advantageously, a plastic coating. The acoustic energy of the *b* and *p* sounds is dissipated by a turbulence produced when the waves impinge on the spring, which allows only a small fraction of these waves to pass at their original velocity.

Accordingly, a feature of the invention relates to suspending and acoustically coupling an operator's headset to an acoustic ear insert.

A further feature of the invention lies in employing a custom-molded plastic acoustic ear insert as a support for an operator's headset, on which the latter may be rotatably positioned.

A still further feature of the invention resides in a combination of added adjustments enabling the pick-up tube to be positioned and retained at any selected position adjacent the operator's mouth without impairing the acoustic couplings.

A still further feature of the invention involves a spring-like puff screen that alleviates the distortive effects of sounds such as *b* and *p*.

Other objects and features of the invention will be readily discernible in the description to follow of an illustrative embodiment thereof and in the drawing in which:

FIG. 1 shows a headset in place upon an operator;

FIG. 2 is a perspective of the headset;

FIG. 3 is a perspective showing the ear insert and the mounting coupling;

FIG. 4 is a perspective in expanded form showing the elements of the headset;

FIG. 5 is a perspective view in partial cutaway of the housing and acoustic tube mounting; and

FIG. 6 is a side perspective of a distortion reducing screen.

FIG. 1 shows a headset embodying the inventive concepts in place on an operator and designated generally as 10. Essentially, headset 10 comprises acoustic pick-up tube 20 and housing 30. A cord 60 attaches to housing 30. Pursuant to a fundamental aspect of the invention, headset 10 is suspended completely from an acoustic ear insert or earpiece 70, shown in FIG. 3 and described in detail later. This manner of suspension eliminates need for head straps or other supportive structure.

As shown in FIGS. 2 and 4, pick-up tube 20 comprises a plastic tube 21 at the end adjacent the operator's mouth and a rigid tube 24 at the other end. Tube 21 may be made with cellulose acetate and advantageously includes a straight section followed by a curved section 56 near the wearer's mouth. Tube 24 is preferably of stainless steel and includes an acoustic ball-joint 25 at one end. Ball-joint 25 is made advantageously of stainless steel or a suitable lightweight material and, as in FIG. 5, provides a mounting for tube 21. Ball-joint 25 joins the housing in a slight interference in a resilient fitting 26 of neoprene or an equivalent, which serves as a frictional mounting socket. The fitting 26 is enclosed in a retainer 27 that seats in housing 30, and that includes a longitudinal acoustic passage 39. Tube 20 may be swivelled within the socket through a considerable circular arc, e.g., 15 degrees. A wide range of adjustments of the end of speech tube 21 with respect to the operator's mouth is thus possible, even without changing the position of housing 30 on earpiece 70.

Pursuant to the invention, tube 24 telescopes and rotates within the straight portion of tube 21 in a light friction fit therewith. A metal ferrule 23 is crimped to plastic tube 21 in order to retain an acoustic and mechanical sealing washer 29 around tube 21, in a substantial friction fit. The curved section 56 together with the ball-joint feature allows axial clearance for tube 21 so that the open end of the tube can always be positioned next to the wearer's mouth. The longitudinal and rotational adjustment in conjunction with curved section 56 allows a full range of positions to accommodate any ear-to-mouth geometry for either male or female wearers. Tube 21 may be removed for replacement easily by a light pulling, but will retain stably any position of adjustment in which it is placed. Advantageously, tube 21 may be transparent so that any dust or foreign matter accumulation can be spotted and removed.

Pursuant to one aspect of the invention, a screen 55 covers the open end of plastic tube 21 to overcome sidetone effects caused particularly by *b* and *p* speech sounds. As shown in FIG. 2 and again in FIG. 6 in greater detail screen 55 is an elongated coil with a coned-in helical end 57. Spring 22 is made advantageously of steel music wire coated with a hard smooth plastic. The adjacent coils are closely spaced and the end helix spirals into a center point. Spring 55 serves to reduce the puff distortions by causing a turbulence in the speech air stream which helps reduce its forward velocity and dissipates some of its energy. The puff sounds are further reduced by a sintered disc 38 at the end of the tube by means of dissipation.

While the described puff screen may, of course, be employed to advantage on any acoustic pick-up tube, it is especially valuable to the instant invention because it helps make practicable the suspending of the headset from an acoustic ear insert. The tight acoustic seal between insert and ear transmits sound essentially without loss, so that without the screen the acoustic blasts to the ear resulting from the puffs would be severe.

As seen in FIG. 4, a disc of porous material 38 such as sintered stainless steel is situated in tube 21 inwardly of screen 55, to damp resonant peaks resulting from standing waves. Retainer 27 is attached and acoustically sealed to housing 30 by a clip 31 that fits through a pair of opposed slots 28 in the sides of the retainer. A flange 37 on fitting 26 snugly seats to an aperture 32 of partition wall 33 within housing 30. To the other side of wall 33 is a recess 34 into which transducer mounting unit 40 fits.

Unit 40 consists of a receiver-transducer 41 and transmitter-transducer 42, advantageously mounted at right angles to each other and individually surrounded by a form-fitting cushion of rubber-like material 43. Transducers 41 and 42 are of the miniature balanced armature variable reluctance type. This transducer can be obtained either as a receiver or as a microphone. The receiver, with the proper type coupling, can develop sound pressures in the ear that can be significantly higher than those produced by conventional receivers for the same electrical input. In the form of a microphone used in conjunction with an amplifier as, for example, that described in W. J. Brown patent application Ser. No. 455,714, filed May 14, 1965, and assigned to applicant's as-

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96

signee, the transducer can deliver to the telephone line electrical power higher than that of the headset carbon microphone widely used in the industry. The impedance of transmitter 42 is a few thousand ohms at 1000 c.p.s.: that of receiver 41 is a few hundred ohms at 1000 c.p.s.

Apertures 44 are provided in the cushion 43 at two points. One point coincides with the acoustic aperture 32 that passes acoustic waves through housing 30 from tubes 21 and 24. The second lines up with an acoustic aperture 45 in housing 30, as shown in FIG. 4, that connects to earpiece 70. Aperture 45 occurs throughout the length of an acoustic fitting 46 that is mounted on housing 30 opposite the terminus of cord 60, and to which in accordance with the invention the supportive earpiece is fastened.

Unit 40 and terminal block 50 comprise in effect a single module that requires only manual insertion and not leads, that facilitates manufacture and that allows easy field replacement of transducers if necessary, from an on-hand supply. By this construction, enough room is saved in housing 30 to include other devices therein as, for example, a clock-suppressing varistor if desired.

A top transducer mounting unit 40 is a terminal block 50 that includes a first and a second pair of spring connectors 51 and 52, advantageously having a high palladium content. Spring connectors 51, 52 have sufficient tension to accommodate the various fits between the housing and the end cap. Block 50 is formed of a stiff, glass fiber-filled nylon resin. Electrical connections (not shown) are effected between connector pair 51 and receiver-transducer 41, and also between connector pair 52 and transmitter-transducer 42.

An end cap or cover 61 is molded directly onto the end of cord 60. A plurality of contacts—in this instance, four—are connected to the conductors of cord 60 and also molded directly into cap 61. Each contact 65 lines up with and touches a separate one of the spring contacts of connectors 51 and 52. Pursuant to an important aspect of the invention, molding of cap 61 directly to cord 60 eliminates need for a stayband, which reduces weight and saves space. Cap 61 has a locking tab 64 which catches beneath a lip 35 in housing 30. A pair of legs 62 each with an outwardly-extending end nub 63 are molded integrally with cord 60. Legs 62 fit into recess 34 and the nubs 63 lock into corresponding grooves 36 in the sides of housing 30 to effect the final closure generally of cap 61 upon housing 30. Cap 61 fits onto housing 30 so that cord 60 is parallel to tube 24. This makes it possible to wear the set comfortably upon either ear.

In accordance with a prime aspect of the invention, as shown in FIG. 3, support for the headset 10 is given by acoustic earpiece or ear insert 70. Earpiece 70 is custom-molded to fill the outer ear cavities of the wearer and includes an acoustic passage 73 between the innermost end and its outer coupling 71. An annular groove 72 around the inner diameter of coupling 71 allows earpiece 70 to be snapped on over a lip 47 on fitting 46 in a light interference fit. When so attached, housing 30 is rotatably adjustable with respect to earpiece 70. A disc of porous sintered steel 74 is lodged inwardly of lip 47 to suitably damp the response peaks of the acoustic system of the receiver. Separate plug inserts must be molded for left and right ears. In practice, each wearer is responsible for his or her own inserts, including storage and occasional cleaning.

Another important advantage of supporting the headset from an ear insert is that there is little or no low overhanging mass involved, to distract or disturb the operator. Also, since the entire headset is held essentially to the ear, no discernible movement of inertia can be produced by turning of the head. Moreover, what little torque is applied to the insert by the movement of the headset and speech tube is in the direction of the outer ear helix which serves to secure it further. Additionally, the unobtrusiveness of the set resulting from its lightness and close fit to face, contributes much to its acceptance by telephone operators and consequently to better operator service.

The operation of headset 10 is simple, involving simply snapping together of housing 30 and of insert 70, and then placing of insert 70 into position in the ear and finally adjusting the speech tube to position the puff screen 55 with respect to the wearer's mouth in accordance with the various above-described inventive adjustments. As the entire headset, including a portion of the cord need weigh only about 18 grams, it is unnecessary to support it any way other than that described. However, some operators prefer to support some of the weight of cord 60 with a neck lanyard (not shown) worn in necklace fashion that fastens to cord 60 about two feet away from housing 30. The acoustic leakage losses to the outside are extraordinarily low, due, in accordance with the invention, to the compact tight construction throughout. With the puff screen located about three-fourths of an inch from the user's mouth, a high level of performance will occur regardless of the specific adjustment fit employed.

While several embodiments of the inventive concept have been shown and described, it is to be expressly understood that further changes and modifications may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A telephone headset comprising: a transmitter, a receiver, and means for housing said transmitter and receiver; an acoustic ear insert comprising a rigid plug-like body with an outer surface, an outer ear helix, an ear canal extension and an acoustic through-passage running from said outer surface and including said extension; means for supporting said housing means upon said ear insert outer surface for rotation about an axis which when the insert is being worn is substantially normal to the side of the wearer's head, and means including said support means for acoustically connecting said through-passage and said receiver.

2. A telephone headset in accordance with claim 1 further comprising an acoustic tube having a rigid inner portion with a ball-joint at one end thereof and a curved outer portion slidably and rotatably mounted upon said rigid portion, and means including compliant material mounted adjacent said transmitter for frictionally and swivelably mounting said ball-joint in said housing, whereby said acoustic tube outer portion is selectively positionable with respect to the wearer's mouth without disturbing said headset housing and said ear insert.

3. A headset in accordance with claim 1 further comprising a rigid straight inner acoustic tube, means swivelably retaining an end of said inner tube within said housing, means acoustically connecting said inner tube and said transmitter, a compliant outer acoustic tube, means including a straight portion of said outer tube for slidably and rotatably mounting same upon said inner tube in a slight interference fit, and means including a curved end portion of said inner and outer tubes for effecting an adjustable clearance between said inner and outer tubes and the user's jaw, whereby the entrance of said outer tube is positioned next to the user's mouth regardless of head shape.

4. A headset in accordance with claim 3 wherein said outer acoustic tube further comprises means, including an elongated open wound steel spring axially aligned with and fixedly mounted on said tube end and having an inwardly-directed helical outer end, responsive to high-energy bursts of acoustic signals impinging thereon for creating an air turbulence thereby to dissipate said energy and reduce sidetone effects of said bursts.

5. A headset in accordance with claim 1 wherein said housing means further comprises a container portion for supporting said transmitter and said receiver, a contact board including a plurality of contact springs, a plurality

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Ex. 67 (277)

of electrical connections between said contact springs and said transmitter and receiver means, and a cap portion comprising a plurality of electrical contacts for effecting contact with respective ones of said contact springs.

6. A telephone headset in accordance with claim 1, wherein said housing support means comprises a lipped fitting, and said acoustic passage at said ear insert outer surface includes a corresponding annular groove to accommodate said lipped fitting in a light interference fit, thereby to enable said ear insert to be snapped on and off of said housing.

References Cited

UNITED STATES PATENTS

2,904,640	9/1959	Dreher et al.	179—156
2,566,313	9/1951	Cates	181—22
3,184,556	5/1965	Larkin	179—156
3,280,273	10/1966	Hygstad et al.	179—156

WILLIAM C. COOPER, *Primary Examiner.*

(291)

EP0863

Ex. 71

(130)

UNEX LABORATORIES, INC

PLAINTIFF'S EXHIBIT 72

ROANWELL CORP.

70 SERIES HEADSET PROJECT

Initial Report - First Week - Sept 26 to October 3rd.

BACKGROUND: - As a result of meeting held on Friday, Sept 26th between Mr. Woodbridge and Mr. Nichols of Unex, and Mr. Powers, Mr. Potter, Mr. Mol, Mr. DeParis, Mr. Morrison, and Mr. Klock, general working agreements and design objectives were set for developing a new head set.

INITIAL STUDY: -A review of Roanwell's objectives, related designs, assorted models and parts, and drawings was made to study the problems envolved. The initial Roanwell #2 and #3 layouts for a 70 Series headset provided good starting designs, lacking only details and minor refinements for a possible end product.

STUDY OF ALTERNATIVES:- Several design possibilities were rough sketched with brief Pro and Cpn comments, as were various possible ear locations, disconnect and wire termination considerations (See sketches #1,2,3,6,7).

BEST INITIAL SELECTIONS: - Two alternate designs were rough sketched in some detail (See #4 and #5), and rough wooden models made to show the approximate size and wearing possibilities. An attempt was made to incorporate and list some new features not in the origional #2 and #3 designs as variations for possible consideration.

NEXT STEP: - Based on our joint evaluations of the various design features to date, more detailed drawings, models, or performance tests can now be scheduled on the more promising ideas.

REFERENCE DATA: - Three Knowles Electronics technical bulletins are loaned with this report as general information on the effects of tubing length, size, etc on transducer performance.

N. P. Nichols
10/3/69

EX.72 (293)

F0660
002496

Sketch 1

POSITIONING:

	PRO	CON
(1) IN THE EAR	MAX OUTPUT CLEAR OF GLASSES	RT + LT PROBLEM APPEARANCE POOR INSECURE
(2) TOP OF EAR	(2) MAX EAR FLAP BUT THIN	TOO THIN FOR TIGHT & SMALL EARS OR USE WITH GLASSES

	PRO	CON
(3) HEARING AID BEHIND EAR STYLE	(5) SECURE, CONCEALED, BUT	SOME TROUBLE WITH GLASSES AND SMALL TIGHT WOMEN'S EAR
(4) LOW SLUNG	GOOD COMFORT " APPEARANCE " TUBE POSITIONING NO GLASSES PROBLEMS SECURE ANY CASE THICKNESS SHORTER INPUT TUBE	EAR HOOK SIZING EL SIZING [illegible] OUTPUT TUBE = LOWER RESPONSE FREQUENCY.
(5) UNDER SLUNG	GOOD COMFORT FOR ANY CASE THICKNESS	POORER APPEARANCE LESS STABLE & SECURE

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UNEX LABS

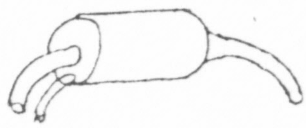
[illegible]
9/30/65

Sketch 2.

A. rmative Designs

Ⓐ Simple Cartridge Types

PRO - CON

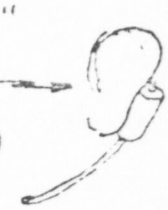


OVER EAR — (TOO FAT)

BACK OF EAR " "

LOW BEHIND (OK) —

UNDER (INSECURE)



Ⓑ Behind the Ear
Hearing Aid Type

ROUND SECTION (OK, if low like above)

FLAT SECTION (OK, if thin enough for small women's ears)

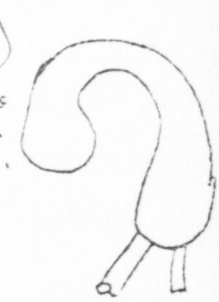
(Interferes with glasses if worn high)

Ⓒ Divided Types

Needs 180° Swivel

(RIGHT + LEFT PROBLEM)
IF ONE SOLID HOUSING

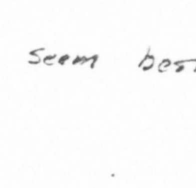
(TOO BULKY)



Ⓓ Hanging Types

(NOT SECURE)

IN THE EAR

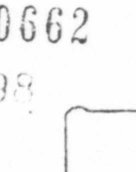


(INSECURE)

UNDER

BEHIND

(BETTER)



COMMENT A + B seem best

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295

UNEX LABS

9/30/59

CYL - TYPE

Sketch #3

Design Problems:

1) Best location on Ear
2) Best size + shape with existing parts
3) Best wearing comfort + security
4) Positive cavity seals
5) Easy disconnect + service, all parts.
6) Easy production assembly
7) Easy low cost tooling + parts
8) Swivel vs formable input tube
9) Type of ear tip for good seal, all sizes
10) Adjustments for all ears - easy fitting
11) Max dependability + Shock resistance
12) Feedback elimination, mountings, leaks magnetic coupling, reflection, etc
13) General use appeal
14) Case closing means

F 0663 296

002499

CYL - TYPE

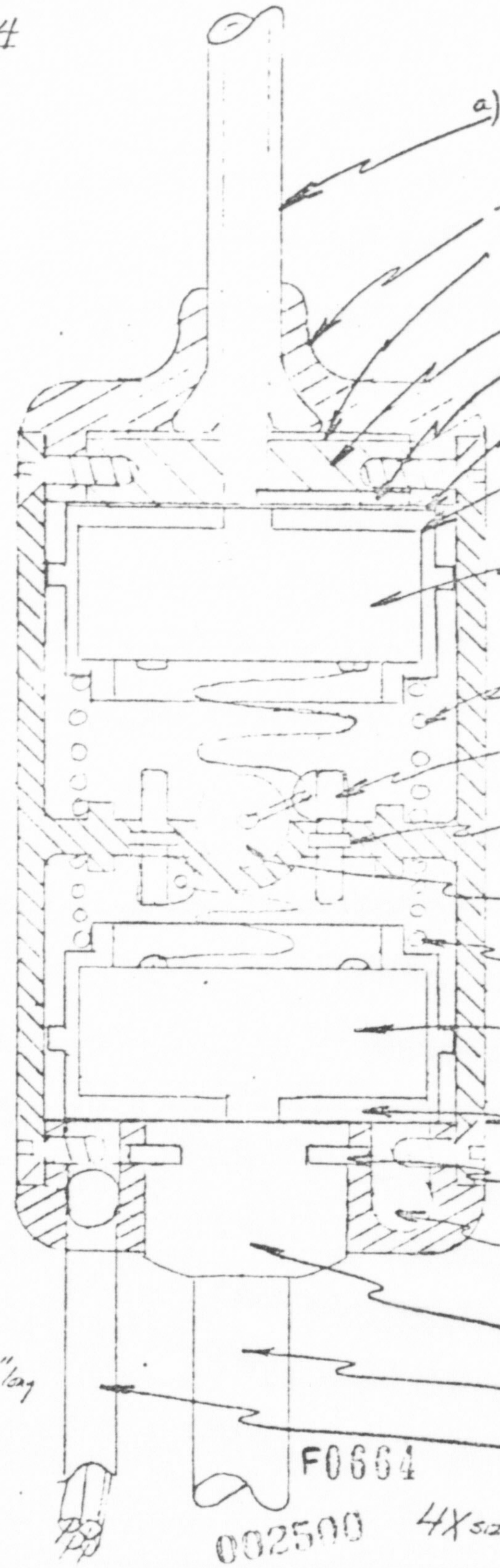
Sketch

LAYOUT No 4

SIMPLE CARTRIDGE FORM FOR POSITION #4

Features

1) Simple tooling —
2) Easy service —
3) Positive seal, input to output —
4) Using existing:
   - Boots
   - Tubes
   - Springs
   - Transmitter
   - Receiver
   - Varistor
   - Screen
   - etc
5) Non-Hearing Aid shape —
6) OK for Position # 4 fit, any size ear or head —
7) Functional appearance —
8) New Parts:
   - Plastic - 4 pcs
   - Terminal posts - 4/unit
   - " clips - 4/unit
9) Size - approx — .700" Diam by 1.320" lg



F0664

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UNEX LABS
HATHORNE, MASS

002500 4X size

NDM 10/2/69
Sketch No. 4

LAYOUT No 5

FLAT TYPE for
for position #3 or #4

Features

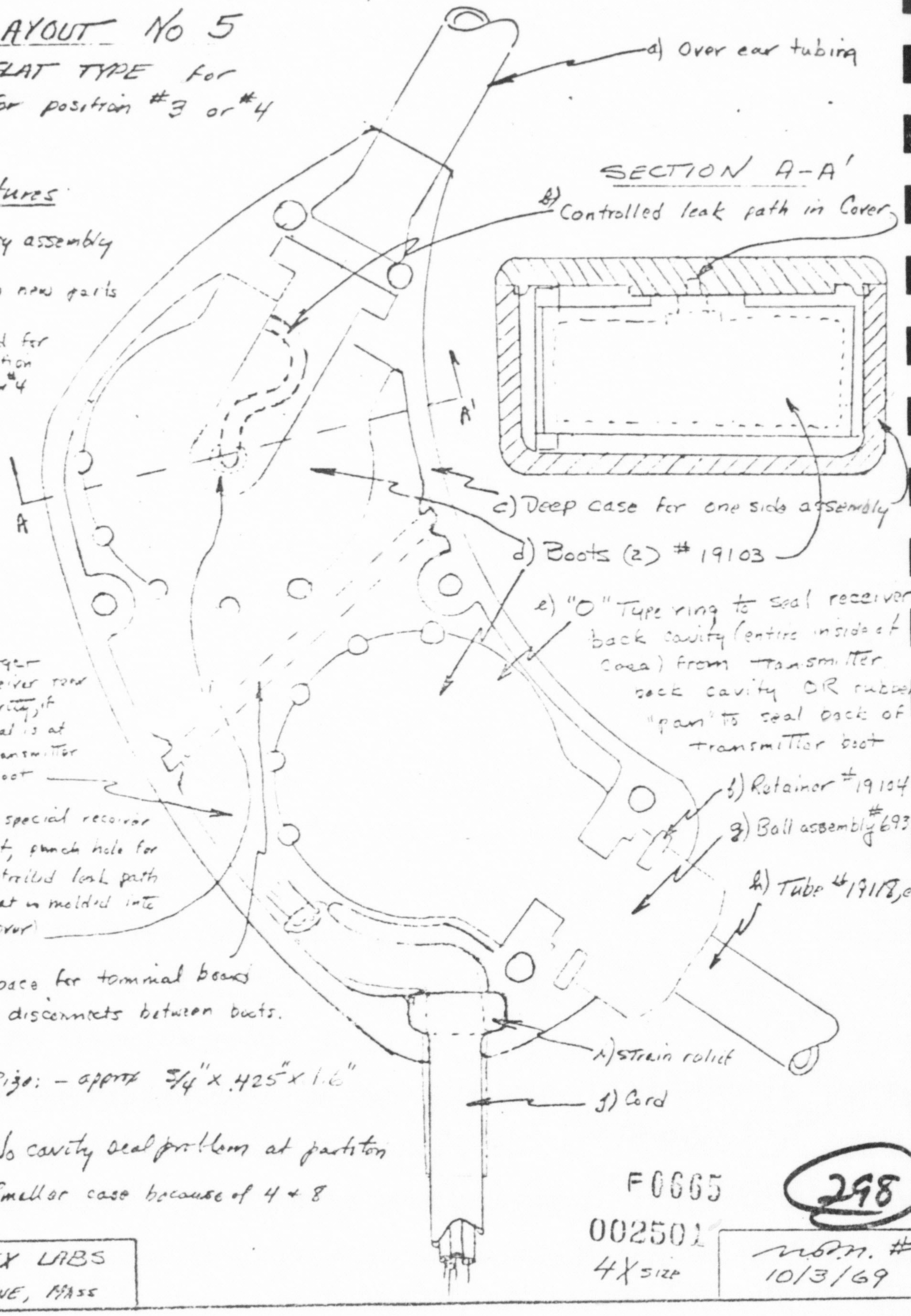
1) Easy assembly

2) Few new parts

3) Good for position #3 or #4

4) Larger receiver rear cavity, if seal is at transmitter boot

5) No special receiver boot, punch hole for controlled leak path (that is molded into cover)



6) Space for terminal board & disconnects between boots.

7) Size: - apprx 3/4" x .425" x 1.6"

8) No cavity seal problem at partition

9) Smaller case because of 4 + 8

F0665
002501
4X size

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UNEX LABS
HATHORNE, MASS

n.o.m. #
10/3/69

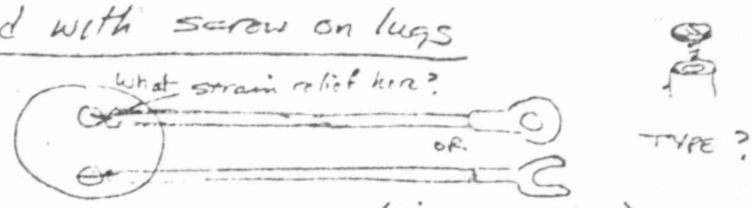
Sketch #12

Sketch # 6

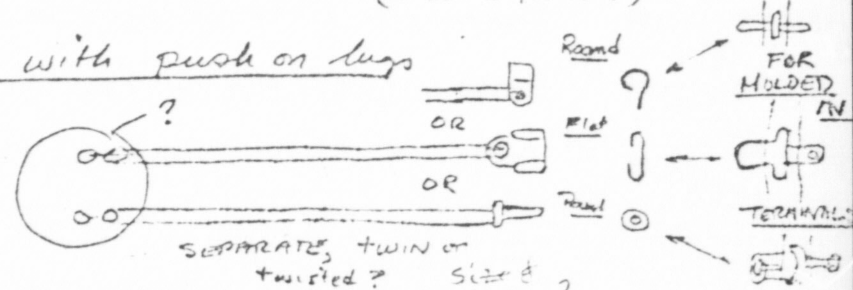
Question – Method desired for

TRANSDUCER DISCONNECT ?

(A) Soldered lead with screw on lugs



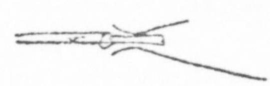
(B) Soldered lead with push on lugs



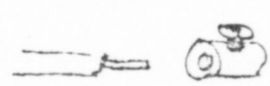
(C) SCREWS ON TRANSDUCERS ?

Can this be done ?

(D) SPRING CONTACTS



(E) SCREW ON TERMINAL



(F) OTHER

F0666 (299)

002502

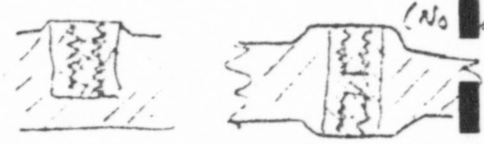
UNEX LABS

10/1/69

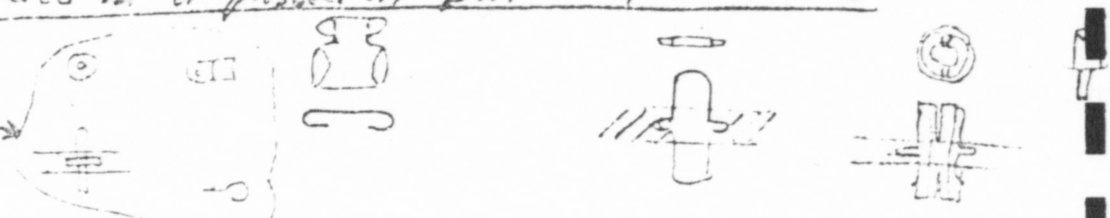
Sketch # 7

TERMINAL STYLES ?

(A) Molded in or pressed in screw bushings



(B) Molded in or pressed in pin or flat contacts



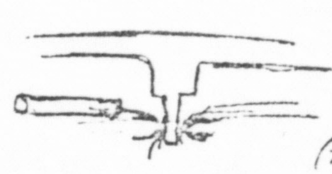
(C) Sub strip, with terminals

(various shapes + terminal types possible)

(D) Solder-in wires (assumed undesirable)

(E) Wedged in contacts,

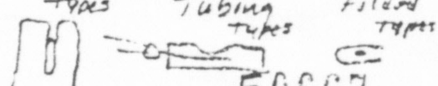
eyelet + wedge, etc



(too big uncertain

(F) CRIMPED CONNECTIONS

(assumed poor)



(G) WELDED (assumed poor)

F0667
002503

200

MGA
10/1/..

ROANWELL
CORPORATION

DATE July 24, 1969

TO H.W.Clark

FROM H.C.Potter

cc: R.W.Howell
R.E.Anslow
L.R.Birdsall
H.C.Mol
R.T.Ennis √

SUBJECT INTELLIGENCE ON PACIFIC PLANTRONICS

REF.

PLAINTIFF'S EXHIBIT
93

First let me congratulate you on getting the first real concrete information on Plantronics' new MS50-80 "behind the ear" headset! Also relay my thanks to our friend in Chicago, and let him know that we will be happy to return the favor some day.

This additional intelligence on the MS50-80 now raises some additional points and questions:

1. PPI says that they intend to have the new headset KS'd, and that it will be available "through your local telephone company later this year". If it is indeed being evaluated in regard to a possible KS approval, it would seem that we might be able to get some additional information (unofficially, of course) through some of our Western Electric and AT&T contacts. This could also mean that the "major customer" evaluating the new headset, as mentioned in PPI's news release, might be the Bell System rather than FAA, NASA, etc.

2. Several technical questions remain unanswered in the data we have received thus far:

   a. Their literature says "the basic elements of the MS50-80 were developed for astronauts in the U.S. aerospace program. A rugged headset, it is dependable even under constant use." These statements would seem to imply that they are using new, more rugged elements in this headset than the old MS50.

   b. They mention an "automatic switch-gain control" that is activated entirely by sound, and automatically reduces volume when no one is speaking. This sounds like the feature incorporated in the 61A amplifier.

   c. No mention is made of the location of the amplifier. It is not part of the clothes clip (as it was in the MS50), so I suspect it is in the plug. At least, it does not appear that the capsule is large enough to contain an amplifier, unless it is an I.C.

F 0537

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cont'd Ex 73 (301)

PACIFIC PLANTRONICS

d. The literature mentions an "extremely lightweight cord".

e. The "strain relief clip" and lanyard used with the MS50-80 appear to be much more practical and less expensive to manufacture than the locket and lanyard assembly used by Western Electric on the 61A.

f. It is not entirely clear in the literature whether the headset is intended to be worn with either ear, or just the left ear. They say that "wearing the unit on the left ear is usually more convenient for right-handed people - the cord then hangs on the left, out of the way." From this I would gather that it is possible to wear the unit on the right ear as well.

3. In regard to applications, PPI's news releases state that the prime markets are business-oriented users, such as stock-brokers, purchasing agents, personnel administrators, etc. However, the person at PPI with whom our friend talked said that the new headset is intended for use in both central offices and PBX applications.

I believe that we should continue our search for additional data on this headset, specifically to obtain answers to some of the questions raised by the above points. I assume that you and Bob Ennis will take the necessary action to get something started.

This raises a question implied in my June 6, 1969 memo entitled "Recommendations on Competitor Intelligence". In this memo I suggested certain information that we should try to obtain on all important customers, and I also raised the question as to which department and individual should be responsible for obtaining information such as this on our competitors. Although it seems logical that the Marketing Dept. have this responsibility, we are also in the process of discussing ways of unloading some of these non-selling activities from the salesmen so that they can spend more time in direct selling activities. I would like to receive your suggestions, following which we should discuss this at one of our weekly operations meetings.

H. C. Potter

F0538

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hcp;gw

302

PLAINTIFF'S EXHIBIT 74

Roanwell CORPORATION

ROANWELL BUILDING · 180 VARICK STREET · NEW YORK, N.Y. 10014

YUKON 9-1090 · TELETYPE 212 640-4791

Sept. 26, 1969

Mr. James O. Woodbridge
Executive Vice President
Unex Laboratories, Inc.
Hathorne, Mass. 01937

Dear Mr. Woodbridge:

The following terms and conditions shall apply to the purchase order which we are planning to place with you for development work.

Please signify your agreement by signing and returning a copy of this memo to me.

1. All information disclosed by Roanwell in the performance of the outlined task is confidential. All drawings done in the performance of the task shall be marked "Confidential, shall not be disclosed to anyone outside of Roanwell and Unex".

2. All drawings, tooling, fixtures shall become the property of Roanwell Corporation and surrendered upon demand.

3. All patentable ideas resulting from this development shall become property of Roanwell Corporation.

4. Unex shall not sell the end product (as described in the attached Design Objectives dated Sept. 26) or a similar product to anyone but Roanwell Corporation.

5. Unex shall not use this development or the Roanwell relationship for advertising or promotional purposes unless specifically authorized in writing.

(continued)

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Ex. 74 303

Unex Laboratories, Inc.
Ha horn, Mass.

Sept. 26, 196
page 2.

6. As soon as the job which is to be performed is disclosed to Unex, if any conflict arises on proprietary information Unex shall inform Roanwell within a few days.

7. The job shall be performed on a fixed rate basis for a 6 month period. The rates shall be:

Tool & Die Maker	$10.00	per hr.
Technician	$10.00	per hr.*
Assembly & Plastic Molding	$ 6.50	per hr.
Drafting	$ 8.00	per hr.
Project Engineer	$15.00	per hr.**

* Includes equipment already available at Unex.
** This rate assumes that the project engineer performs a combination of engineering and design drafting on approximately 50% - 50% basis.

8. Mr. Nichols or alternate approved by Roanwell, shall be the project engineer on this project and shall be available on a minimum 20 hr. per week basis.

9. Brief and written bi-weekly progress reports shall be made to report status and obtain approval of billing.

10. Partial payments shall be made monthly at 75% of the billed amount and the 25% balance shall be paid upon completion of the project or every three months, whichever is sooner.

11. All direct expenses such as travel, telephone, etc. shall be billed on a cost basis. Any one expenditure exceeding $100 shall be approved by Roanwell prior to commitment.

12. All technical contacts shall be through the undersigned. All other contacts shall be with Mr. Dave DeParis.

Very truly yours,

ROANWELL CORPORATION

Hans C. Mol

Hans C. Mol
Vice President of Engineeri

HCM/gw

F0657

James O. Woodbridge Exec. V.P. 9/26/69 RC 23493

AGREED: James O. Woodbridge Date

002507

304

Attachment to letter dated Sept. 26, 1969
to James O. Woodbridge,
Unex Laboratories, Inc.

70 SERIES HEADSET

DESIGN OBJECTIVES

1. The hoped for end objective is to build a headset which can be used by a PBX operator, without requiring earmolds or any other device unique to the particular operator. The headset shall be usable by either male or female of normal size, (90% of population), either on the right or left side of head. The headsets shall be attached without use of headband, eyeglasses, etc.
2. The headset shall use the transducers supplied by Roanwell and should if at all possible use the vibration isolation boots which are already being used by the transducers.
3. If at all possible, the headset shall use as many parts as possible from the existing headset such as speech tube, ball socket, cord assembly, but not if there is a serious performance compromise.
4. The amplifier will not be part of the design task, and shall not be part of the headset.
5. The output from the headset shall be per the attached spec, which is the approved spec for telephone use.
6. The cord assembly and the transducer shall be easily replaceable preferably without soldering or use of special tools.

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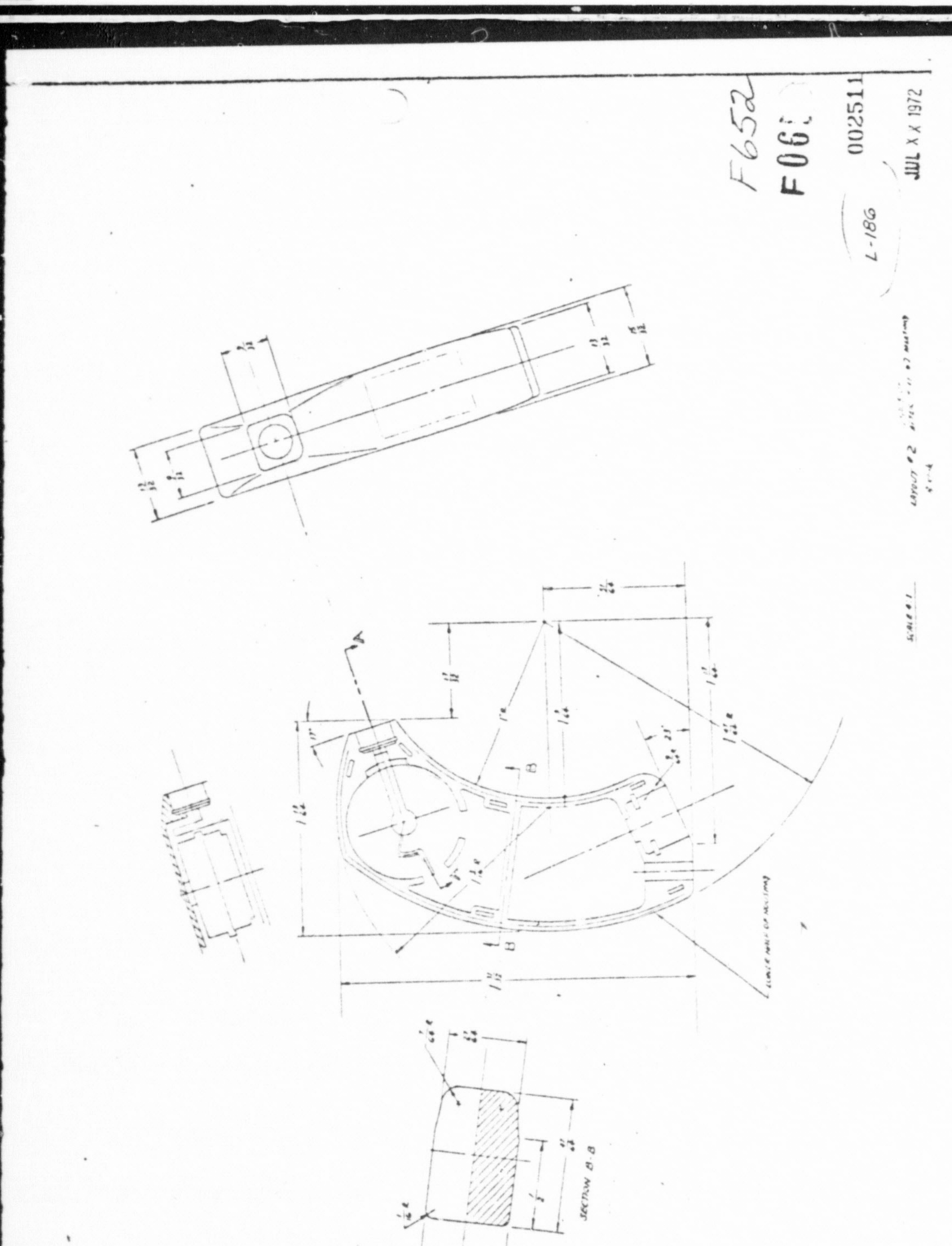
305 JUL

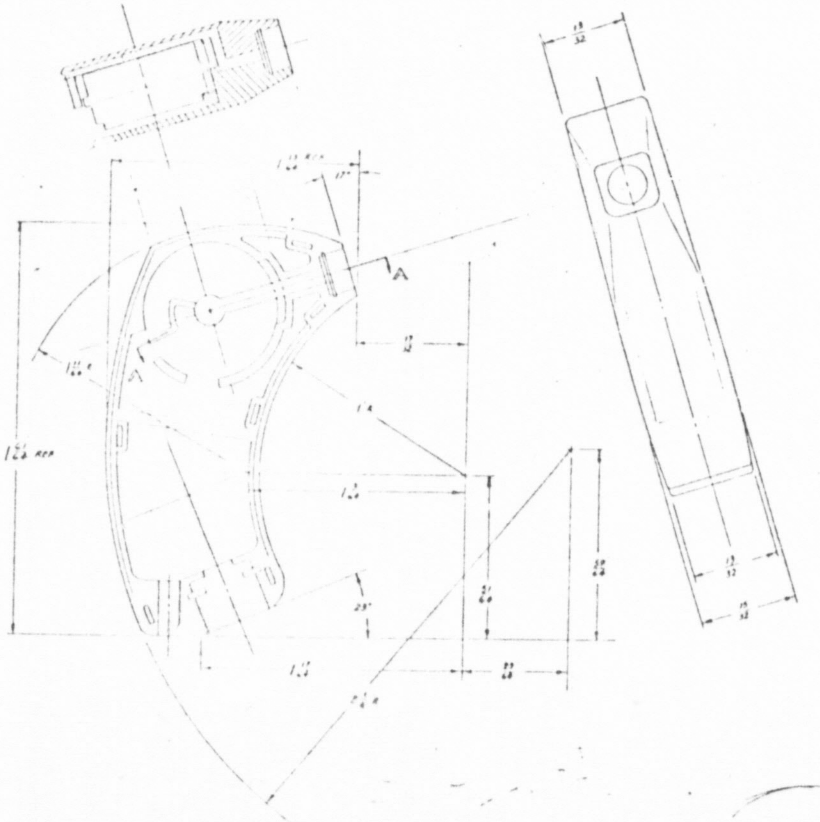
Ex. 71 (29)

PLAINTIFF'S EXHIBIT 75



Ex. 75 (306)

Sketch # 20



Ex. 76 307

L-187

(TO BE USED IF HOUSING #2 SEEMS TOO THICK AT LEADING EDGE)

SCALE 4:1

LAYOUT #3

F 0051

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ROANWELL CORPORATION

70 Series Headset Project

Second Report for period October 6, 1969 to October 21, 1969:

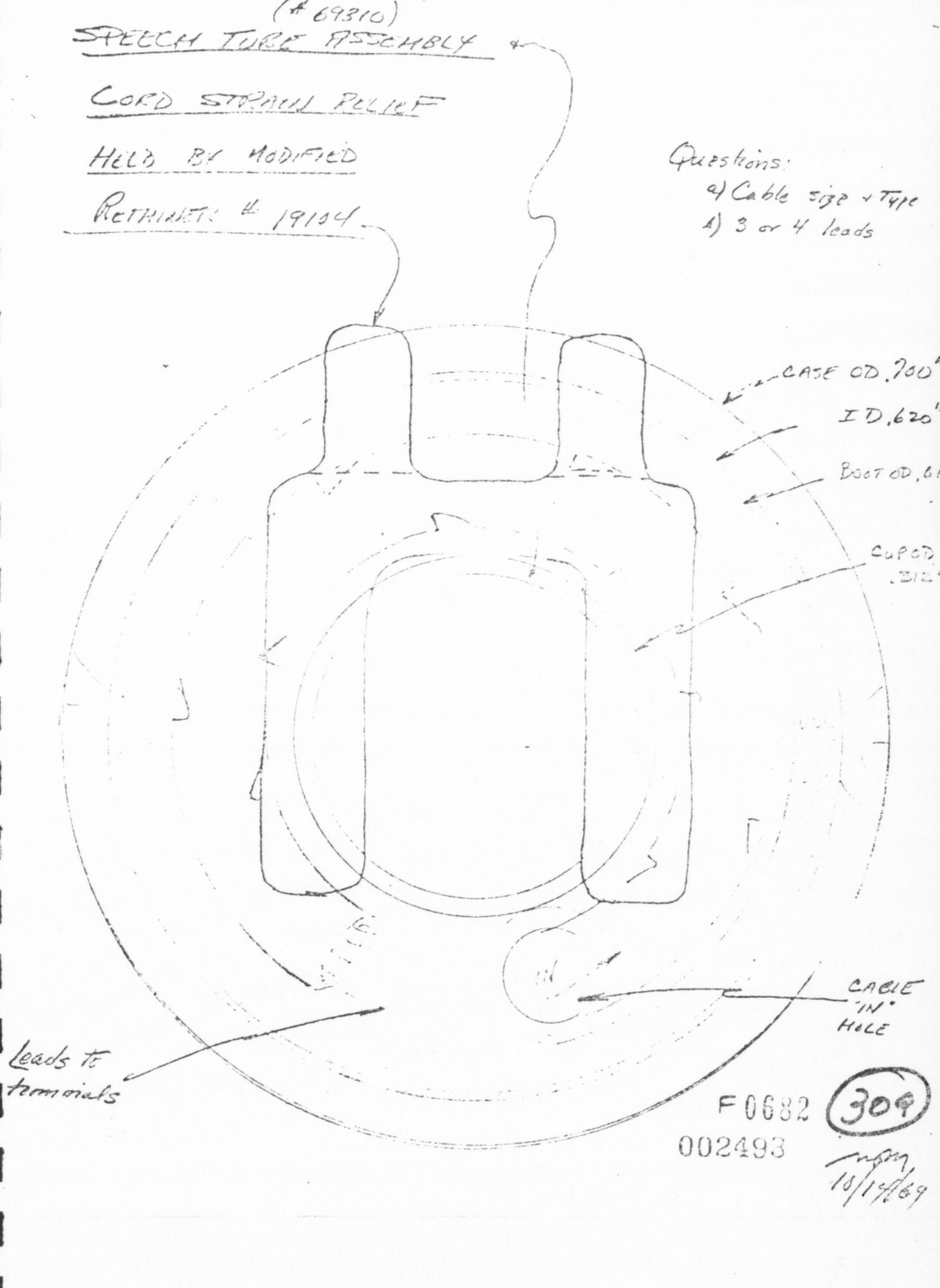
Mr. Woodbridge brought the initial weeks report, drawing and models to New York on Monday October 6, for general discussions. During the second week I largely marked time pending receipt of component parts, and your evaluation of our initial thoughts. However a few hours were spent on further details on the original sketches to check feasibility and clarify design possibilities.

In response to your initial reaction to our first report, I did additional general design and sketches on the possibilities of an over the ear voice tube as suggested by your sales department, more detailed layouts for the flat hearing aid type with one possible terminal construction, additional terminal and strain details for the cylindrical type, and additional wearing and fitting considerations and models.

It is expected at a meeting on Wednesday, October 22nd, we can zero in on best design considerations and proceed on more detailed drawings, initial breadboard testing, or more complete models for evaluation. A survey of operator reactions to various models should probably be done before too much detail drawing is attempted.

R.G. Nichols
10/21/69

Skatch # 9



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mpm
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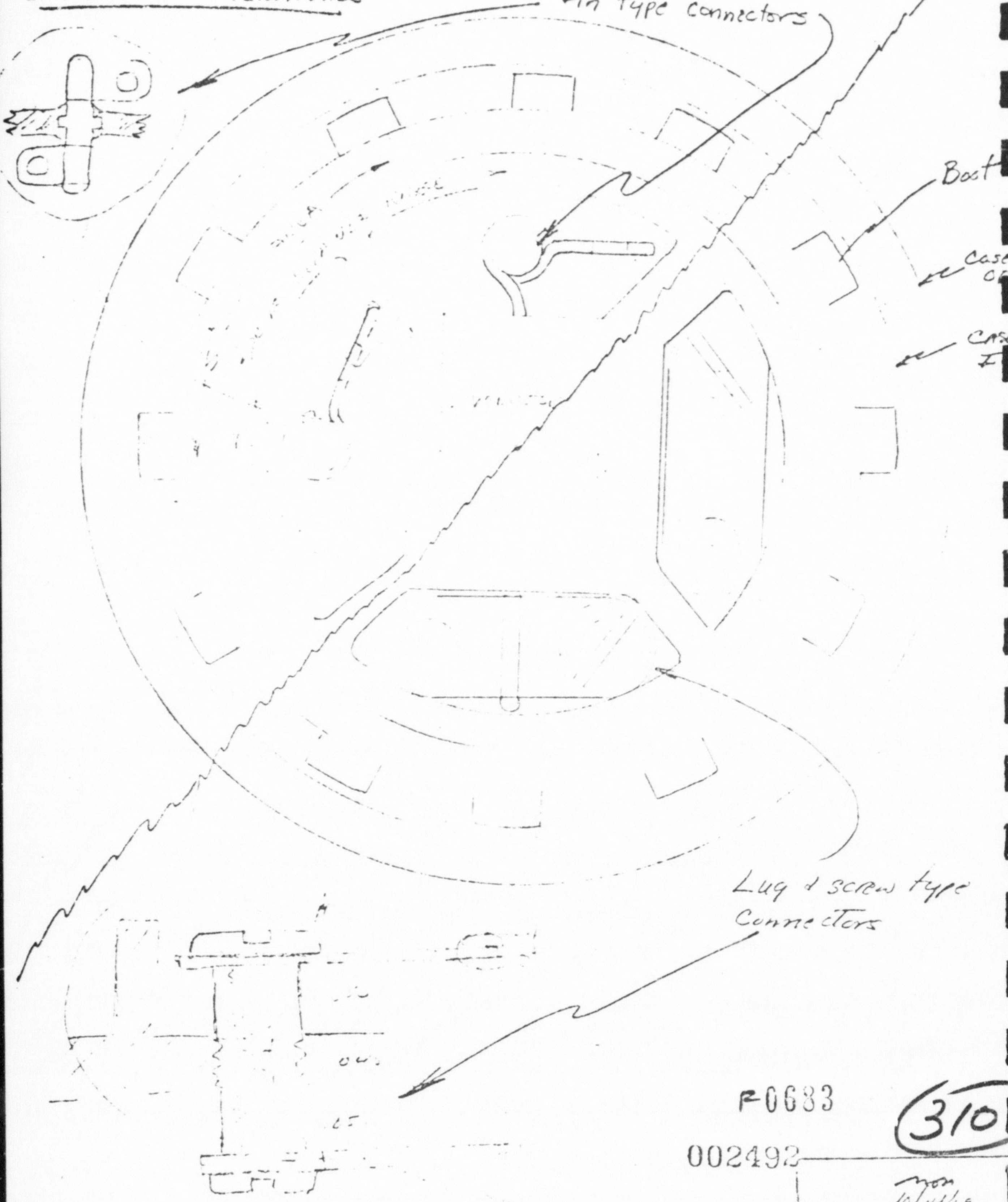
Sketch 10

CYL - TYPE

CROSS SECTION DETAILS
at PARTION + TERMINALS



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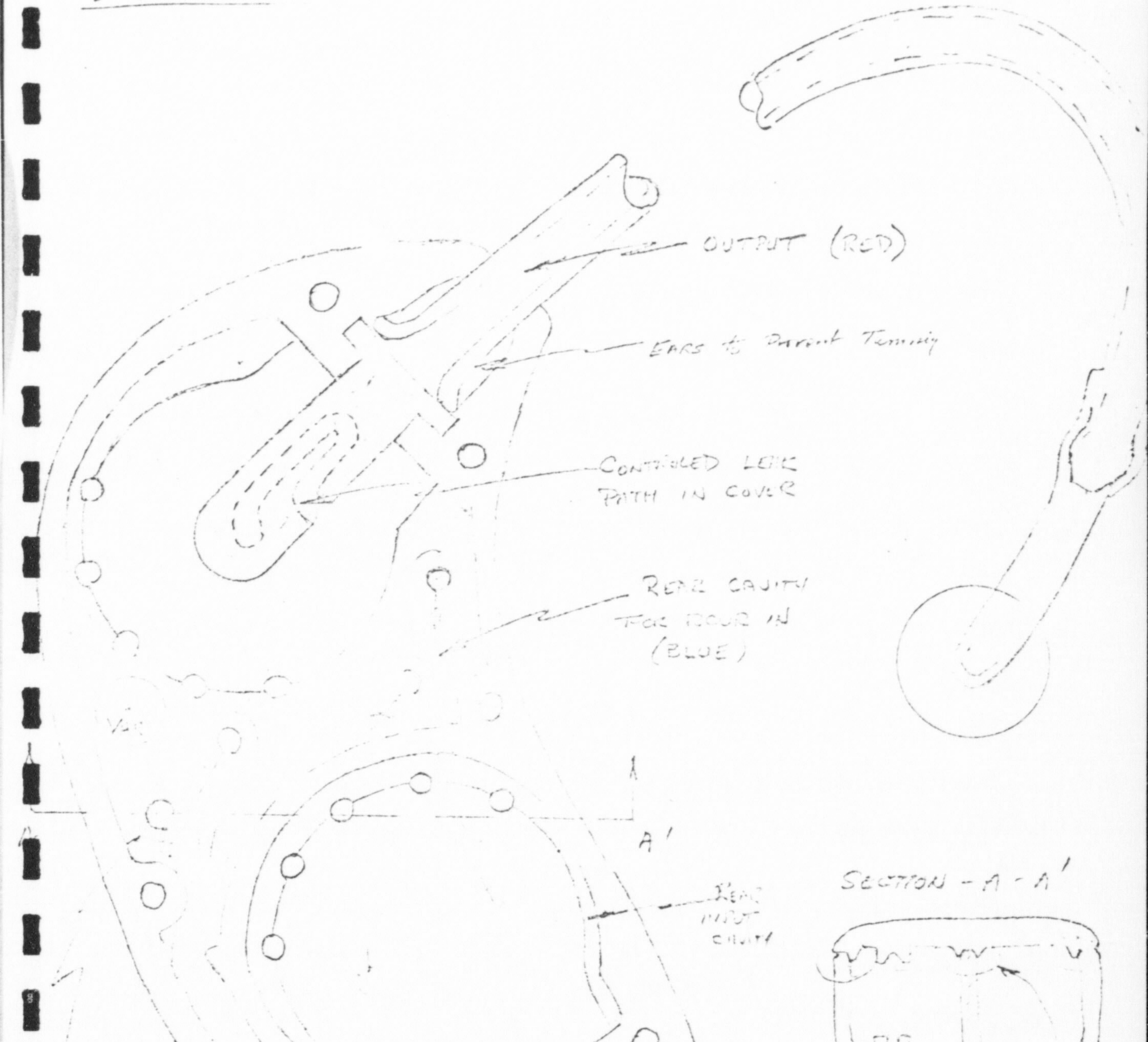
AUSGABETAG: 12. JULI 1962 DAS 1132973

Sketch # 11

[illegible]

UNDER SLUNG



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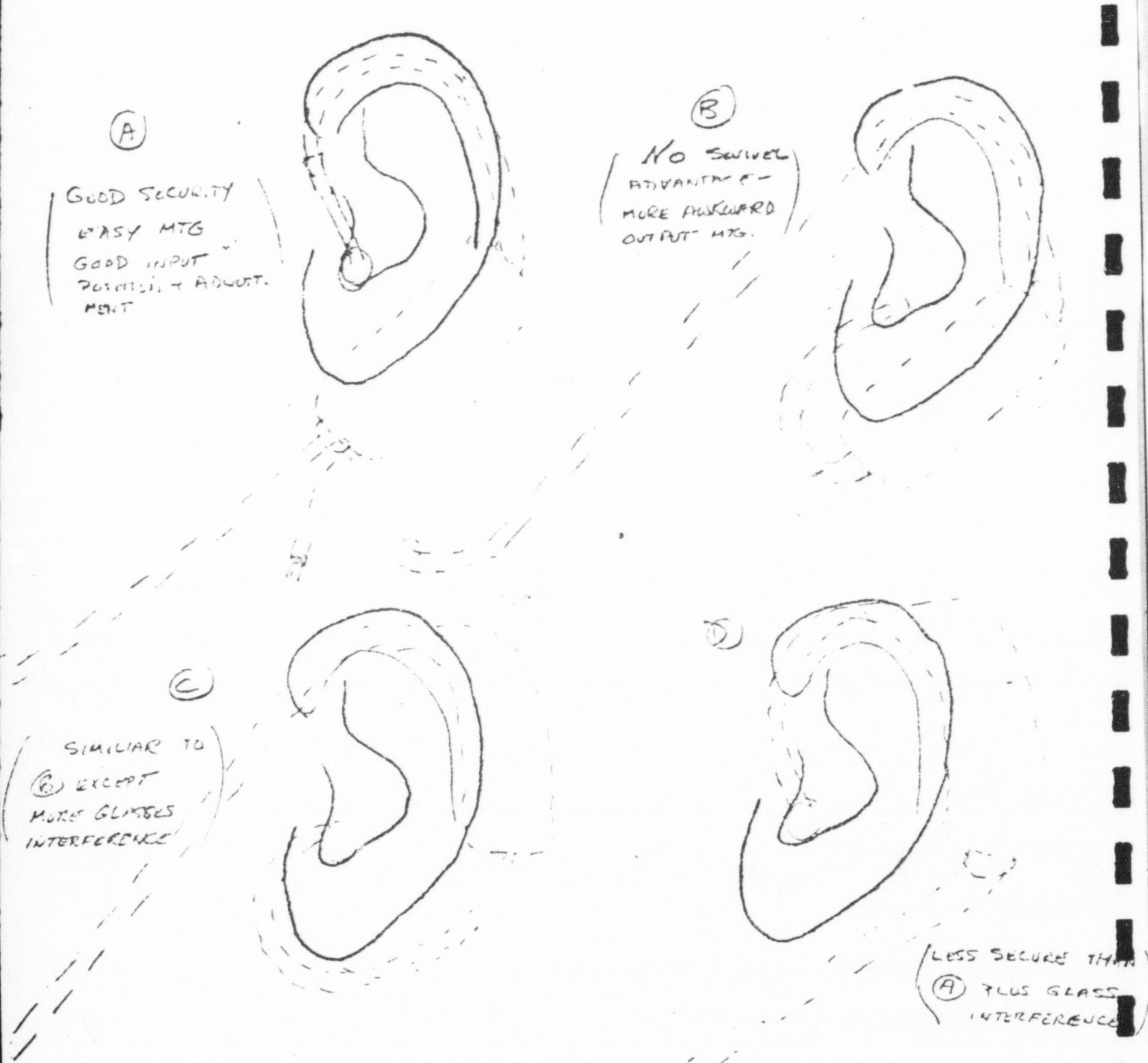
Sketch # 12

OVER EAR INPUT TUBES
VS.
OVER EAR OUTPUT TUBES

&

HIGH VS LOW
UNIT MOUNTING



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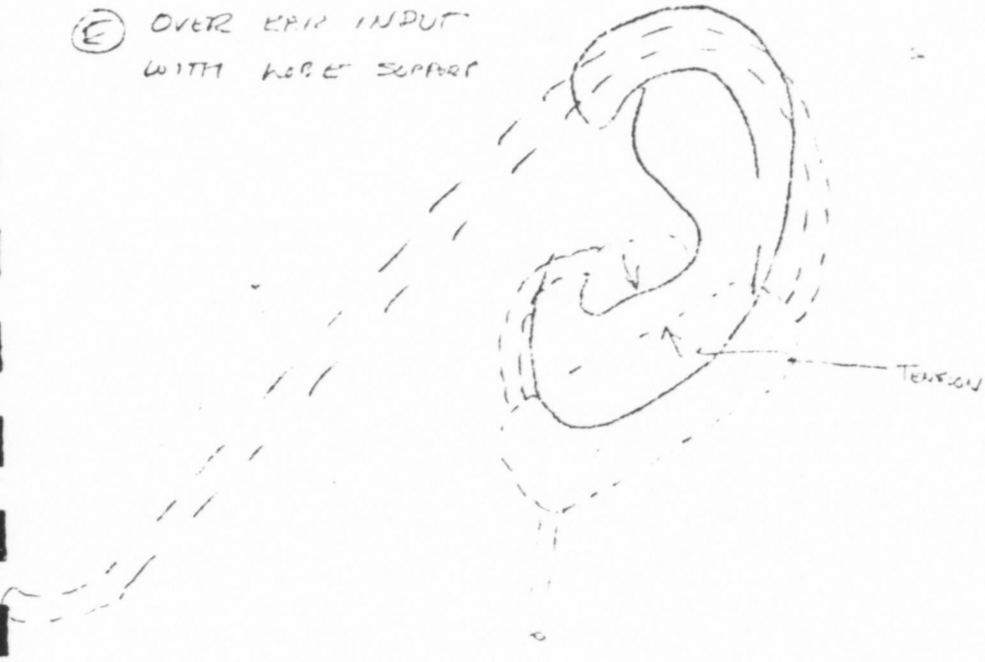
10/14/69

(E) OVER EAR INPUT
WITH LOBE SUPPORT



(FAIR, but fitting
+ Rt + Lt problems)

(F) EAR LOBE
SUPPORTED UNIT

(Poor Security
Fitting + Comfort + Rt + Lt
Problems)

or

(G) LOBE HANGING LIKE
EAR
RING

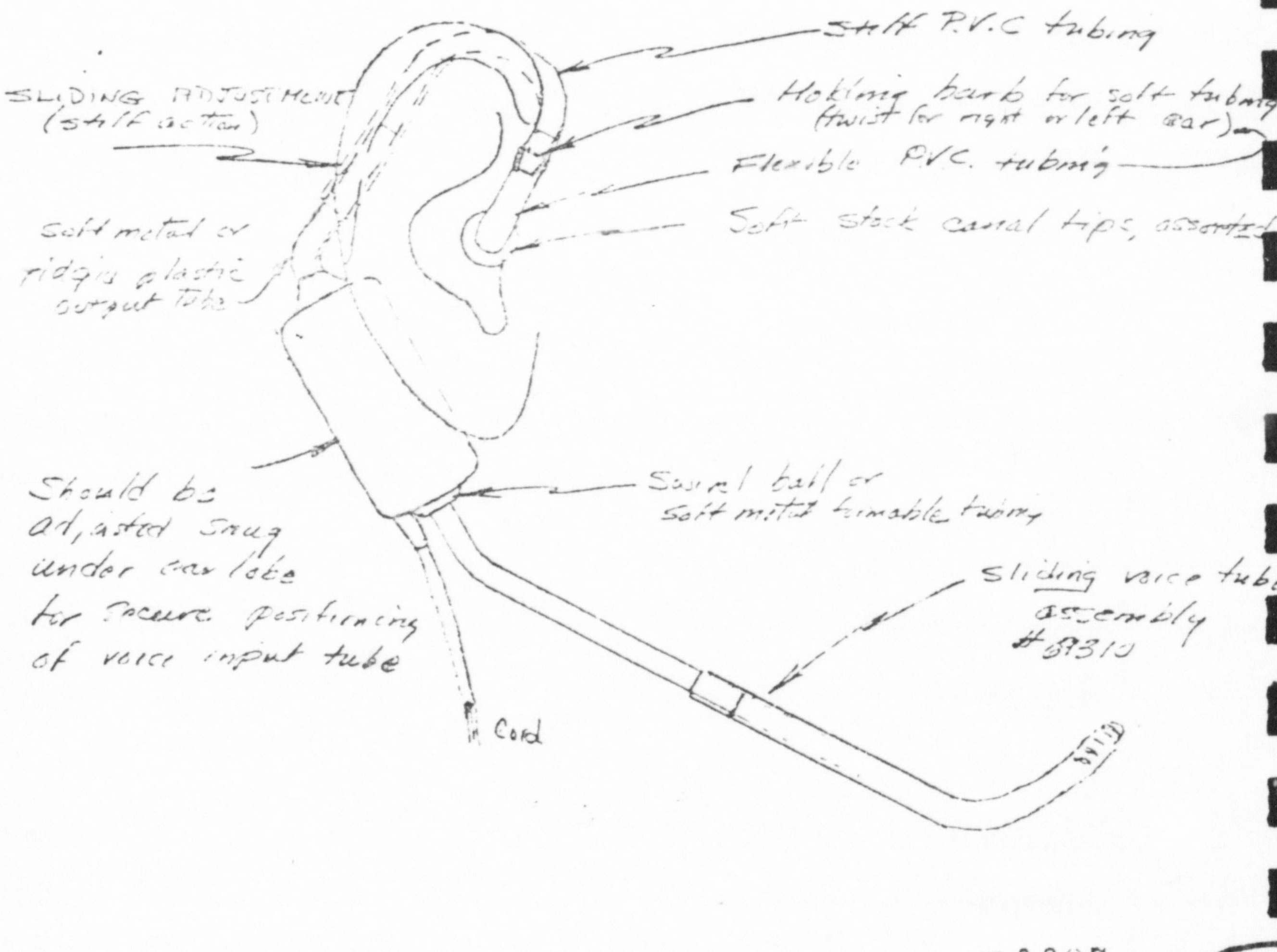
(Poor)

313

[illegible]
13/11/69

Sketch # 14

Adjustable Wearing Setup
for Cartridge Type Unit
in #4 Low slung position



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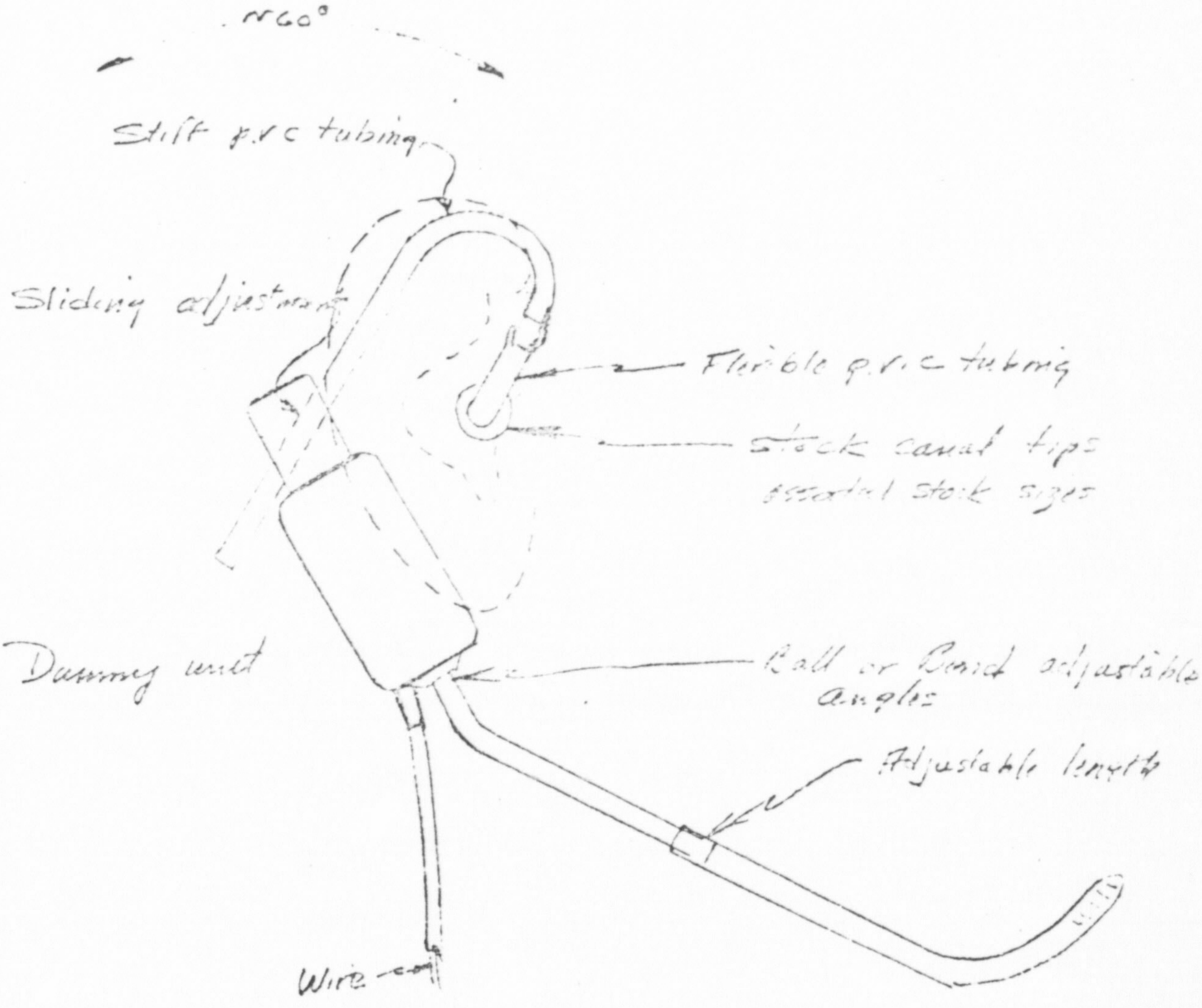
Dummy Fitting Unit
for Cartridge Type Units
in #4 Low slung position



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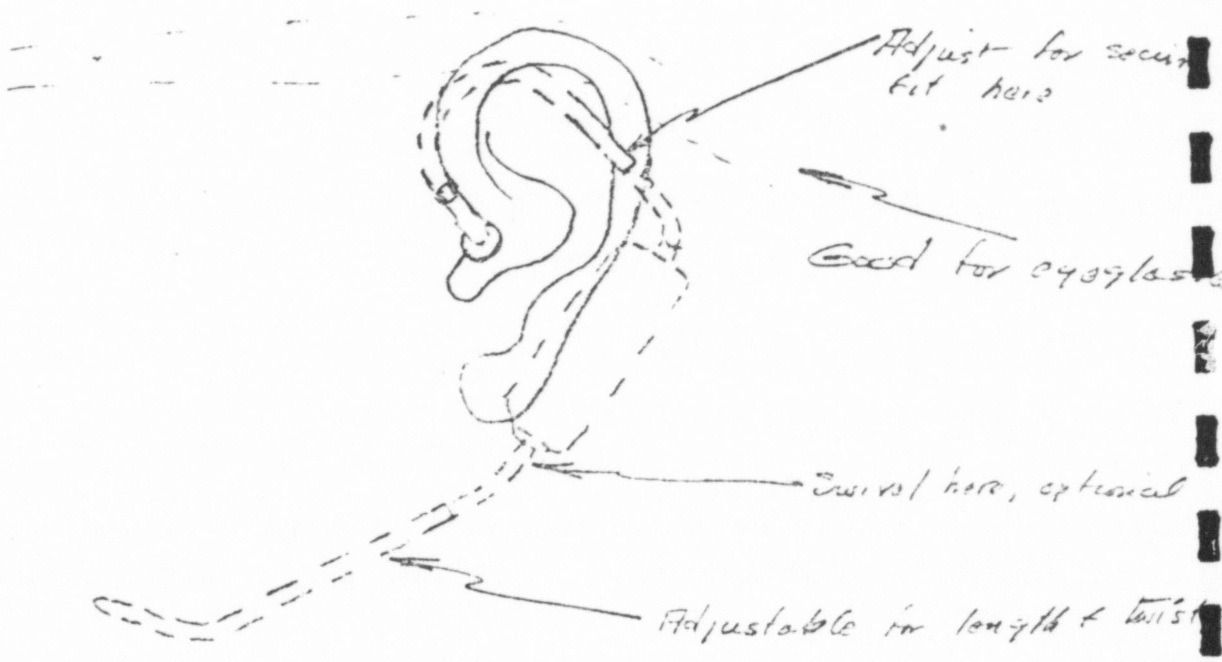
Sketch # 16

Cartridge Type — Low Position



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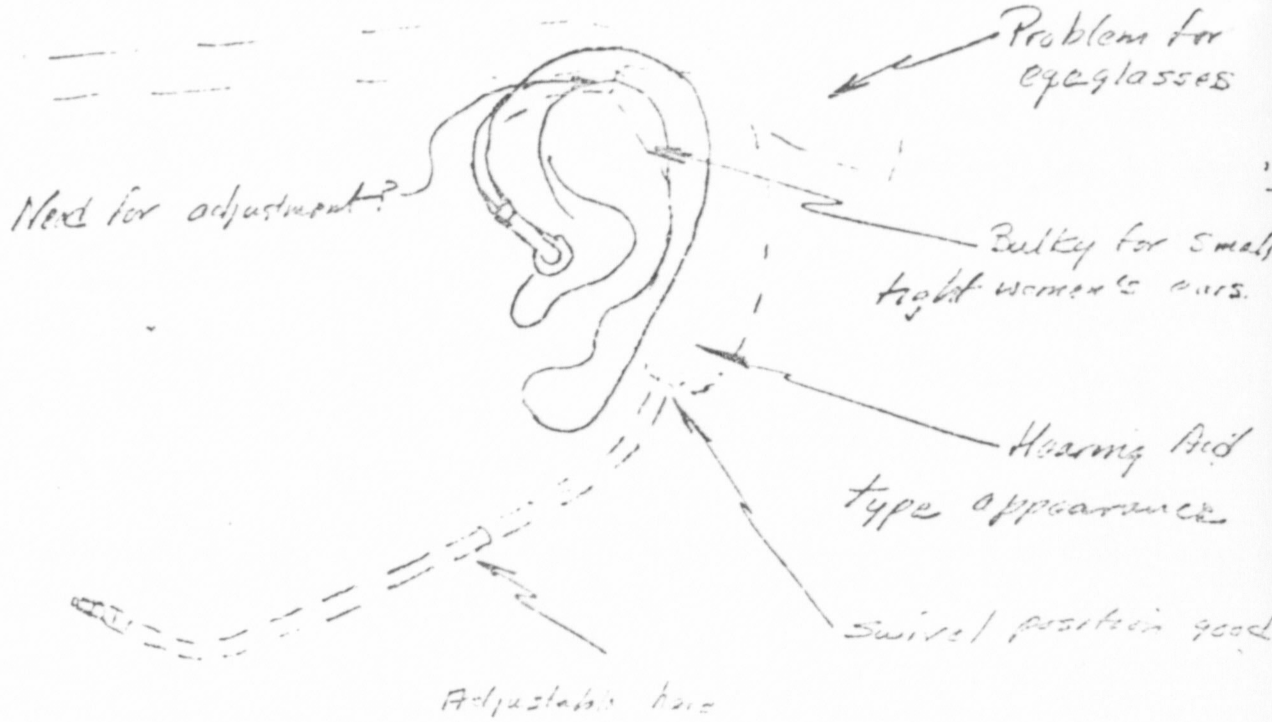
Flat Type — High Position



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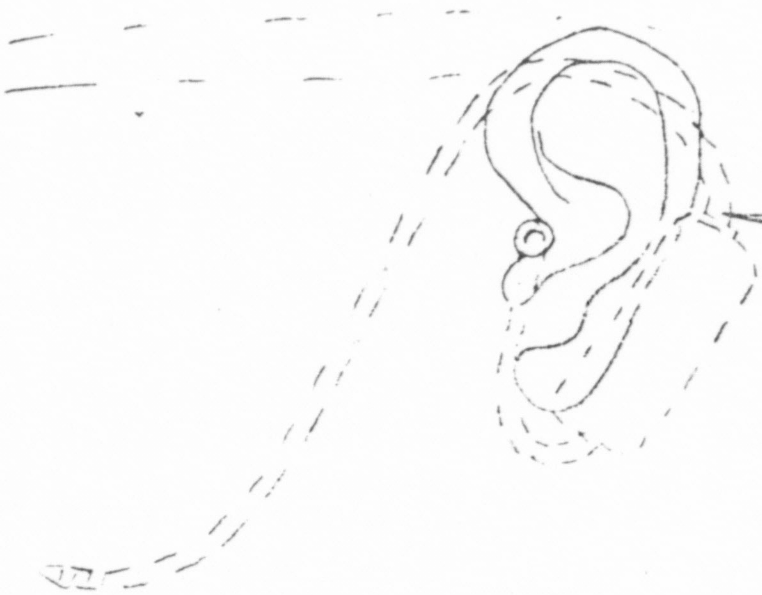
Cartridge 7 pp

Over the Ear Voice Input

Under Ear Output



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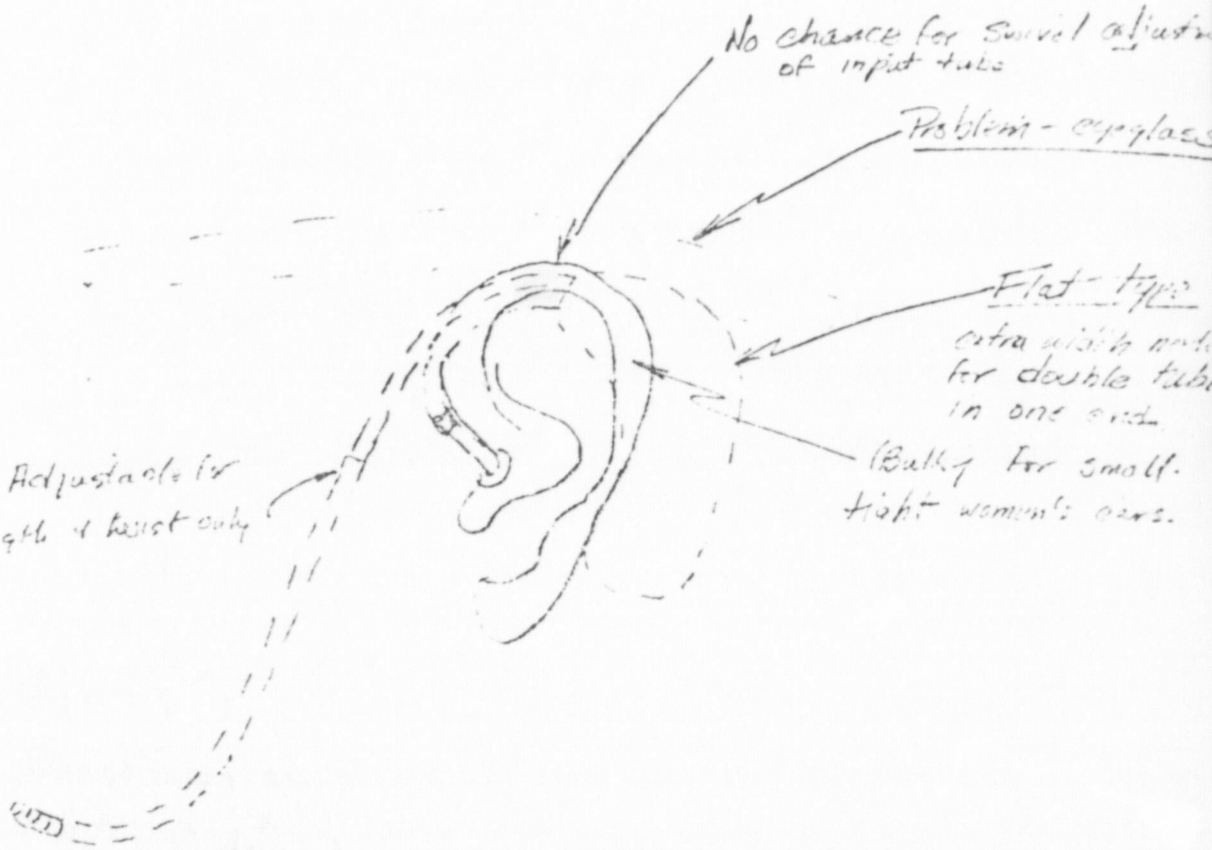
002484 (318)

Sketch # 19

Over Ear Voice Input

Over Ear Output



(See Wooden Model)

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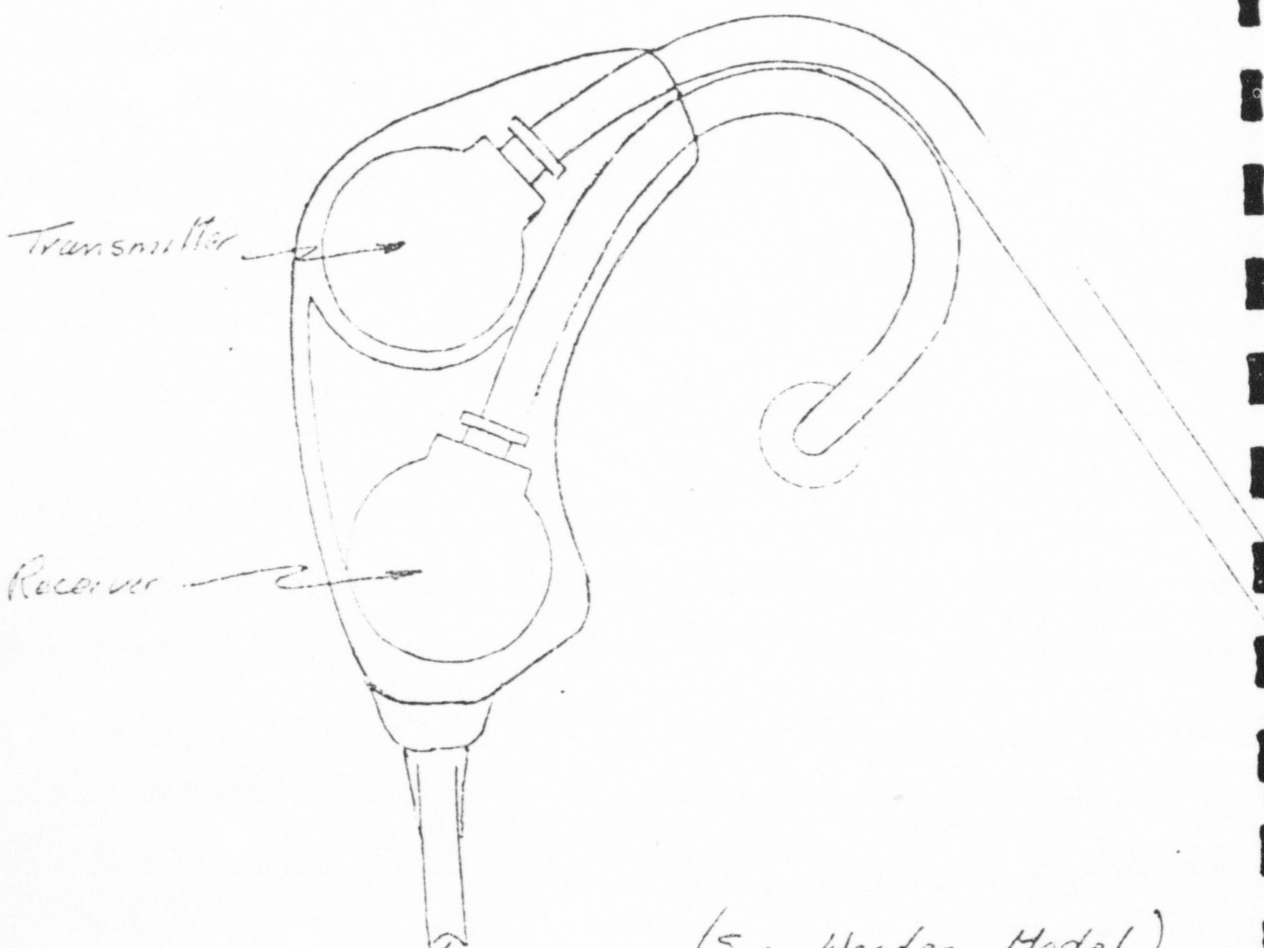
...of the invention is illustrated in the drawing.

Sketch # 20

Flat Type — Over Ear Voice Tube

Basic Layout only



(See Wooden Model)

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00248 (32)

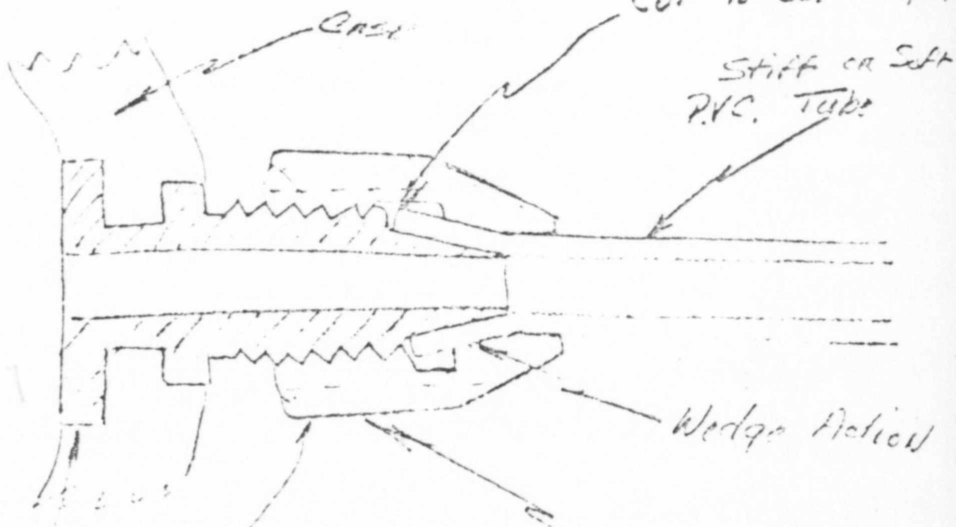
n2x

12, a depression 24 may be provided which matches the dome-shaped bearing face 14

outer aural passage 27. However, this arra...

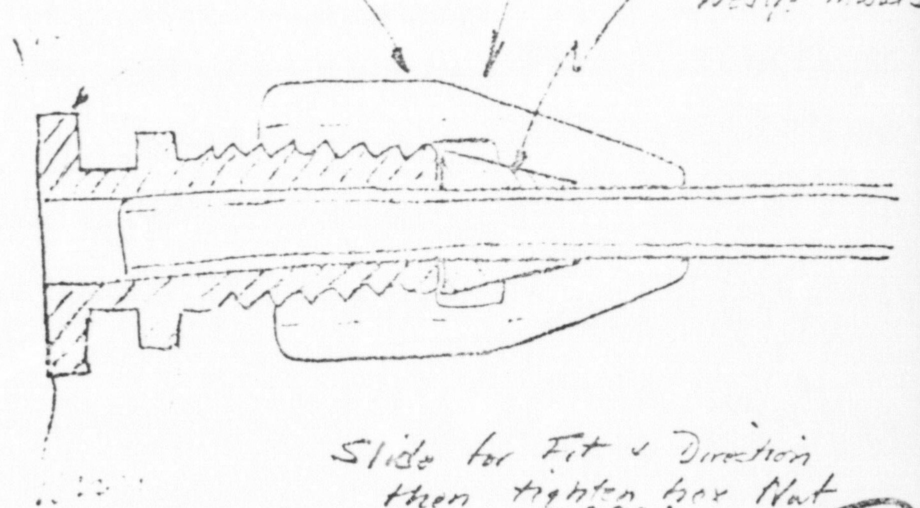
Output Pipe Connector

A) For PLASTIC TUBING



Hex Stock

B) For Metal Tubing



Slide for Fit & Direction
then tighten hex Nut

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Material – S.S. etc

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MOM

outer aural passage 27. However, this arra...

BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

KL. 21 a² 17/03

INTERNAT. KL. H 04 r

AUSLEGESCHRIFT 1 132 973

M 46916 VIIIa/21 a²

ANMELDETAG: 22. OKTOBER 1960

BEKANNTMACHUNG DER ANMELDUNG UND AUSGABE DER AUSLEGESCHRIFT: 12. JULI 1962

Hinter der Ohrmuschel zu tragendes Hörgerät für Schwerhörige

Zusatz zum Patent 1 078 175

Anmelder:

micro-technic Hüber & Co.,
Stuttgart-Degerloch, Löwenstr. 94

Walter Hüber und Klaus Hüber, Stuttgart-Degerloch, sind als Erfinder genannt worden

1

Die Erfindung betrifft eine Weiterbildung des im Hauptpatent 1 078 175 beschriebenen allgemeinen Erfindungsgedankens eines Hörgerätes, bei welchem die dem Mikrophon zuzuführenden Schallwellen auf der Vorderseite der Ohrmuschel aufgenommen und nach elektrischer Verstärkung in einem hinter der Ohrmuschel zu tragenden Gerätegehäuse durch einen Wiedergabe-Hörschlauch einem in den äußeren Gehörgang zu steckenden Ohrpaßstück zugeführt werden.

Die Erfindung besteht darin, daß das in bekannter Weise innerhalb des Gerätegehäuses angeordnete Mikrophon mit einem in der Ohrmuschel etwa am Eingang des äußeren Gehörganges mündenden Schallaufnahmekanal verbunden ist, der vorzugsweise in dem das Gerätegehäuse tragenden, über den oberen Ansatz der Ohrmuschel hinweggreifenden Tragbügel vorgesehen ist. Zur Vermeidung eines besonderen Hörschlauches kann außer dem zum Mikrophon führenden Aufnahme-Hörkanal auch noch ein vom Telephon zum Ohrpaßstück führender Wiedergabe-Hörkanal in dem Tragbügel vorgesehen sein.

Diese neue Gestaltung des Hörgerätes hat den Vorteil, daß die zwischen Mikrophon und Verstärker verlaufenden elektrischen Leitungen innerhalb des Gerätegehäuses liegen und daß trotzdem der Schall hörgerecht an der Außenseite der Ohrmuschel eingefangen wird.

Drei Ausführungsbeispiele der Erfindung sind in der Zeichnung dargestellt. In dieser zeigt

Fig. 1 eine Ansicht der Vorderseite einer Ohrmuschel, an welcher ein Hörgerät mit einem im Tragbügel angeordneten Schallaufnahmekanal und einem von diesem getrennten Wiedergabe-Hörschlauch angebracht ist,

Fig. 2 eine Ansicht der Rückseite der vom Schädel losgetrennten Ohrmuschel mit dem zum Hörgerät nach Fig. 1 gehörenden Gerätegehäuse,

Fig. 3 eine Vorderansicht einer Ohrmuschel mit einem Hörgerät, bei welchem sowohl der Schallaufnahmekanal als auch ein Wiedergabe-Hörkanal in dem Tragbügel für das Gerätegehäuse angeordnet sind,

Fig. 4 einen vergrößerten Querschnitt durch den Tragbügel nach Fig. 3,

Fig 5 eine Vorderansicht einer Ohrmuschel mit einem der Fig. 3 entsprechenden Hörgerät, bei welchem der Schnellaufnahmekanal in einem Schalltrichter mündet, der am äußeren Ende des mit dem Wiedergabe-Hörkanal verbundenen Ohrpaßstückes angeordnet ist, und

Fig. 6 einen von vorn gesehenen Längsschnitt durch den äußeren Gehörgang und die Ohrmuschel eines mit dem Hörgerät nach Fig. 5 versehenen Ohres.

2

Zu dem Hörgerät gehört ein hinter der Ohrmuschel 13 zu tragendes Gerätegehäuse 19, welches das Mikrophon 10, die Batterie 20, den Verstärker 21 und das Telephon 22 umschließt (Fig. 2). Das Gerätegehäuse 19 wird von einem über den oberen Ansatz der Ohrmuschel hinweggreifenden Bügel 18 getragen, der vorzugsweise aus einem thermoplastischen Kunststoff besteht.

Bei dem in den Fig. 1 und 2 dargestellten Ausführungsbeispiel enthält der Bügel 18 nur einen zum Mikrophon 10 führenden Schallaufnahmekanal 30, dessen äußeres Ende auf der Vorderseite der Ohrmuschel, vorzugsweise vor dem äußeren Gehörgang 27 des Ohres mündet, um an dieser Stelle den zu verstärkenden Schall hörgerecht aufzufangen. Das Telephon 22 ist durch einen besonderen Wiedergabe-Hörschlauch 26 mit einem in den äußeren Gehörgang 27 zu steckenden Ohrpaßstück 2[illegible] verbunden.

Bei dem Ausführungsbeispiel nach Fig. 3 ist der Wiedergabe-Hörschlauch 26 nach den Fig. 1 und 2 beseitigt und durch einen in dem Bügel 18 parallel zum Schallaufnahmekanal 30 verlaufenden Wiedergabe-Hörkanal 31 ersetzt, welcher sich in der Bohrung des Ohrpaßstückes 28 bis in den äußeren Gehörgang 27 fortsetzt.

Der Querschnitt des Tragbügels 18 weist somit zwei nur durch eine Zwischenwand voneinander getrennte Kanäle 30 und 31 auf (Fig. 4). Eine akustische Rückkopplung zwischen den beiden Kanälen 30 und 31 findet bei sachgemäßer Au[illegible]g und Materialwahl für den Tragbügel 18 nic[illegible]

Ex. 79

321

Das in den Fig. 5 und 6 gezeigte Ausführungsbeispiel unterscheidet sich von dem vorstehend beschriebenen nur dadurch, daß das äußere Ende des Schallaufnahmekanals 30 in einem Schalltrichter 32 mündet, der am äußeren Ende des Ohrpaßstückes 28 angeordnet und mit diesem fest verbunden ist (z. B. aus einem Stück besteht).

Patentansprüche:

1. Hörgerät für Schwerhörige nach Patent 1 078 175, bei welchem die dem Mikrophon zuzuführenden Schallwellen auf der Vorderseite der Ohrmuschel aufgenommen und nach elektrischer Verstärkung in einem hinter der Ohrmuschel zu tragenden Gerätegehäuse durch einen Wiedergabe-Hörschlauch einem in den äußeren Gehörgang zu steckenden Ohrpaßstück zugeführt werden, dadurch gekennzeichnet, daß das in bekannter Weise innerhalb des Gerätegehäuses (19) angeordnete Mikrophon (10) mit einem in der Ohrmuschel etwa am Eingang des äußeren Gehörganges (27) mündenden Schallaufnahmekanal (30) verbunden ist.

2. Hörgerät nach Anspruch 1, dadurch gekennzeichnet, daß der Schallaufnahmekanal (30) in dem das Gerätegehäuse (19) tragenden, über den oberen Ansatz der Ohrmuschel hinweggreifenden Tragbügel (18) vorgesehen ist.

3. Hörgerät nach den Ansprüchen 1 und 2, dadurch gekennzeichnet, daß der Tragbügel (18) außer dem zum Mikrophon (10) führenden Schallaufnahmekanal (30) auch noch einen vom Telephon (22) zum Ohrpaßstück (28) führenden Wiedergabe-Hörkanal (31) enthält.

4. Hörgerät nach Anspruch 3, dadurch gekennzeichnet, daß der Schallaufnahmekanal (30) in einem Schalltrichter (32) endet, der mit dem äußeren Ende des Ohrpaßstückes (28) verbunden ist.

5. Hörgerät nach Anspruch 4, dadurch gekennzeichnet, daß der Schalltrichter (32) mit dem Ohrpaßstück (28) aus einem Stück besteht.

In Betracht gezogene Druckschriften:
Deutsche Patentschrift Nr. 1 078 175;
deutsches Gebrauchsmuster Nr. 1 735 662.

Hierzu 1 Blatt Zeichnungen

323

AUSGABETAG: 12. JULI 1962

DAS 1 132 973
KL. 21 a² 17/03
INTERNAT. KL. H 04 m

Fig. 1

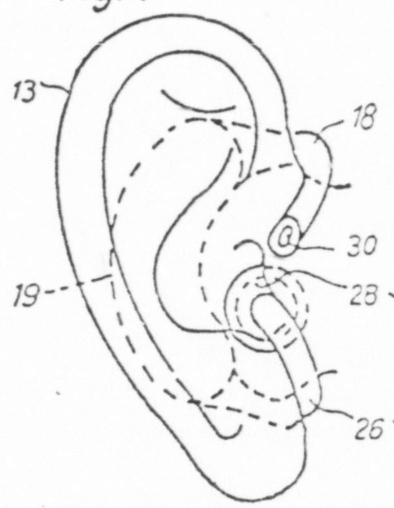


Fig. 2

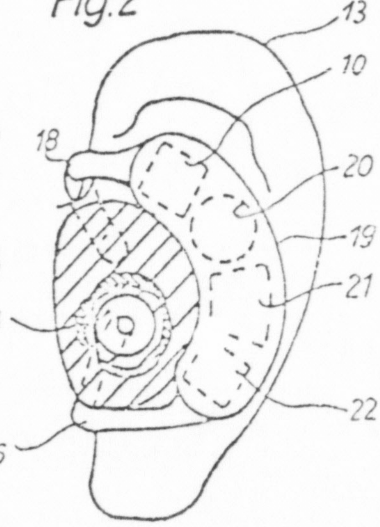


Fig. 3

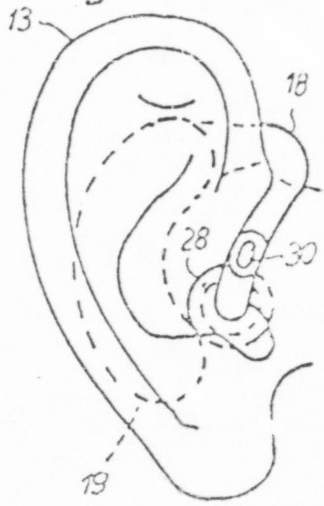


Fig. 4

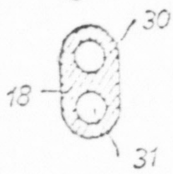


Fig. 5

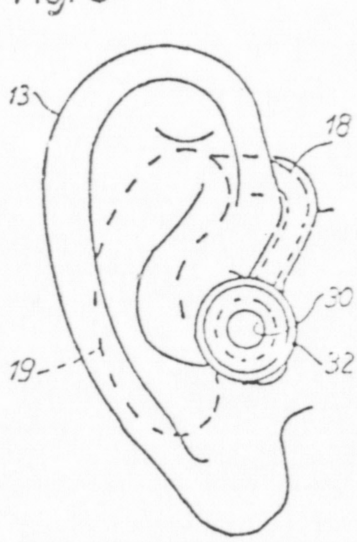
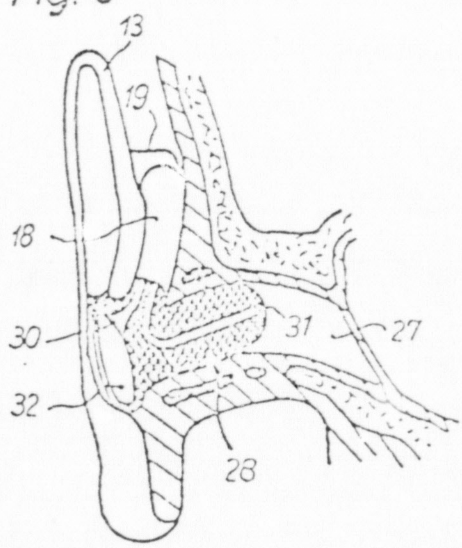


Fig. 6



324

Federal Republic of Germany

German Patent Office

Provisional Patent (DAS) 1,132,973

Cl. 21 a^2 17/03

Internat. Cl. H 04 m

M 46916 VI IIa/21 a^2 Filing date: October 22, 1960

Application made public and provisional patent issued: July 12, 1962

Hearing aid to be worn behind the ear

Addition to Patent 1,078,175

Applicant:

micro-technic Hüber & Co.,
Stuttgart-Degerloch, Löwenstr. 94

Walter Hüber and Klaus Hüber, Stuttgart-Degerloch, have been named as inventors

The invention concerns a further development of the general conception of a hearing aid described in the main patent 1,078,175, where the sound waves to be supplied to the microphone are received on the front of the auricle and after electric amplification in a housing to be worn behind the auricle are fed through a reproduction hearing tube to an ear-piece to be inserted into the outer aural passage.

The invention consists in that the microphone, arranged in known manner inside the housing, is connected with a sound receiving canal which terminates in the auricle approximately at the entrance of the outer aural passage and which is preferably provided in the supporting yoke carrying the housing and engaging over the upper attachment of the auricle. To avoid a special hearing tube, there may be provided, besides the reception hearing canal leading to the microphone, a reproduction hearing canal in the supporting yoke leading from the telephone to the ear-piece.

325

This new design of the hearing aid has the advantage that the electric lines extending between microphone and amplifier lie within the housing and that nevertheless the sound is caught on the outer side of the auricle as in natural hearing.

Three embodiments of the invention are illustrated in the drawing. In it -

Fig. 1 shows a view of the front of an auricle to which is fitted a hearing aid with a sound receiving canal in the supporting yoke and with a reproduction hearing tube separated therefrom;

Fig. 2, a view of the back of the auricle separated from the skull, with the housing belonging to the hearing aid according to Fig. 1;

Fig. 3, a front view of an auricle with a hearing aid where the sound receiving canal as well as the reproduction hearing canal are arranged in the supporting yoke for the housing;

Fig. 4, an enlarged transverse section through the supporting yoke according to Fig. 3;

Fig. 5, a front view of an auricle with a hearing aid corresponding to Fig. 3, where the sound receiving canal opens into a sound funnel arranged on the outer end of the ear-piece connected with the reproduction hearing canal; and

Fig. 6, a longitudinal section, seen from the front, through the outer aural passage and the auricle of an ear fitted with the hearing aid according to Fig

There belongs to the hearing aid an instrument housing 19 to be worn behind the auricle 13 and enclosing the microphone 10, battery 20, amplifer 21, and telephone 22 (fig. 2). The housing 19 is carried by a yoke 18 engaging over the upper attachment of the auricle and preferably consisting of a thermoplastic material.

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In the embodiment illustrated in Fig. 1 and 2, yoke 18 contains only one sound receiving canal 30, which leads to the microphone 10, and whose outer end terminates on the front of the auricle, preferably before the outer aural passage 27 of the ear, in order to catch at this point the sound to be amplified, as in

natural hearing. The telephone 22 is connected by a special reproduction hearing tube 26 with an ear-piece 28 to be inserted into the outer aural passage 27.

In the embodiment according to Fig. 3, the reproduction hearing tube 26 according to Fig. 1 and 2 has been removed and replaced by a reproduction hearing canal 31 extending parallel to the sound receiving canal 30 in yoke 18 and prolonged in the bore of the ear-piece 28 up into the outer aural passage 27.

The cross-section of yoke 18 thus has two canals 30 and 31 separated from each other only by a partition (fig. 4). With proper design and material selection for the yoke 18, acoustic feedback does not take place between the two channels 30 and 31.

The embodiment shown in Fig. 5 and 6 differs from the one described above only in that the outer end of the sound receiving canal 30 opens in a sound funnel 32 which is arranged on the outer end of the ear-piece 28 and is firmly connected therewith (e.g. is made of one piece).

Claims

1. Hearing aid for the hard-of-hearing according to Patent 1,078,175, where the sound waves to be fed to the microphone are received on the front of the auricle and after electric amplification in a housing to be worn behind the auricle are fed through a reproduction hearing tube to an ear-piece to be inserted in the outer aural passage, characterized in that the microphone (10) arranged in known manner inside the housing (19) is connected with a sound receiving canal (30) terminating in the auricle approximately at the entrance of the outer aural passage (27).

2. Hearing aid according to claim 1, characterized in that the sound receiving canal (30) is provided in the supporting yoke (18) carrying the housing (19) and engaging over the upper attachment of the auricle.

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3. Hearing aid according to claims 1 and 2, characterized in that the supporting yoke (18) contains, besides the sound receiving canal (30) leading to the

microphone (10), a reproduction hearing canal (31) leading from the telephone (2[illegible] to the ear-piece (28);

4. Hearing aid according to claim 3, characterized in that the sound receivi[illegible] canal (30) ends in a sound funnel (32) which is connected with the outer end of the ear-piece (28).

5. Hearing aid according to claim 4, characterized in that the sound funnel (32) is of one piece with the ear-piece (28).

Publications taken into account: German Patent No. 1,078,175; German Utility Model No. 1,735,662.

Translated by Carl Demrick Associates, Inc./LH/db

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AUSGABETAG: 31. MÄRZ 1960

DAS 1 073 175
KL. 21a² 17/03
INTERNAT. KL. H 04 m

Fig. 1

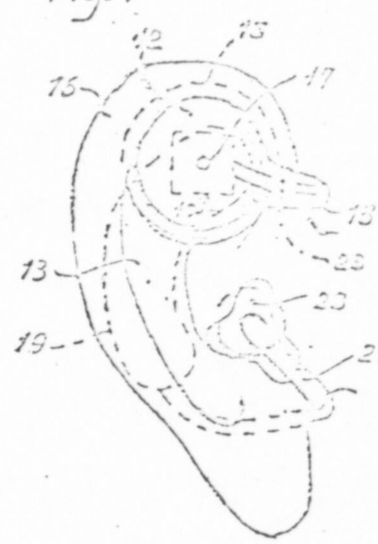

Fig. 2

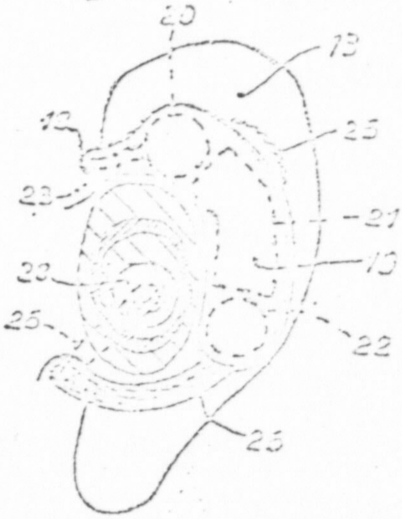

Fig. 3

Fig. 4

Fig. 5

Ex. 81 329

AUSLEGESCHRIFT 1 078 175

M 38539 VIIIa/21a²

ANMELDETAG: 8. AUGUST 1958

BEKANNTMACHUNG
DER ANMELDUNG
UND AUSGABE DER
AUSLEGESCHRIFT: 24. MÄRZ 1960

Hinter der Ohrmuschel zu tragendes Hörgerät für Schwerhörige

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ist als Erfinder genannt worden

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Die Erfindung bezieht sich auf solche Hörgeräte für Schwerhörige, deren bohnen- oder nierenförmiges Gerätegehäuse, hinter der Ohrmuschel liegend, von einem über den oberen Ansatz der Ohrmuschel hinweggreifenden Bügel getragen wird.

Bei bekannten Hörgeräten dieser Art ist das Mikrophon in dem hinter dem Ohr zu tragenden Gehäuse angeordnet. Dies hat den Nachteil, daß die beim natürlichen Hören von der Außenseite der Ohrmuschel aufgefangenen und dem äußeren Gehörgang zugeleiteten Schallwellen das Mikrophon nur auf dem Umweg um die Kante der Ohrmuschel erreichen können und vom natürlichen Hören abweichende akustische Wirkungen hervorrufen.

Es ist weiter bekannt, das Mikrophon am äußeren Ende und das Telephon am inneren Ende eines in den äußeren Gehörgang einzusteckenden und gleichzeitig den Verstärker und dessen Batterie in sich aufnehmenden Ohrpaßstücks anzuordnen. Allein bei dieser Lösung entstehen durch die enge Nachbarschaft zwischen dem Mikrophon und dem Telephon störende Rückkopplungserscheinungen, die ein deutliches Hören verhindern.

Die Erfindung besteht darin, daß das Mikrophon an dem auf der Vorderseite der Ohrmuschel anliegenden Ende des über den Ohrmuschelansatz hinweggreifenden Tragbügels angeordnet ist, während das Telephon im unteren Teil des hinter der Ohrmuschel liegenden Gehäuses angeordnet und in bekannter Weise durch einen um den unteren Ohrmuschelansatz herumgreifenden Hörschlauch mit dem Ohrpaßstück verbunden ist. Auf diese Weise wird erreicht, daß die akustischen Wirkungen, welche durch die Form der Ohrmuschel bedingt sind, wenigstens zum Teil für die Schallaufnahme des Mikrophons herangezogen werden und dem natürlichen Hören nahekommende Schalleindrücke vermitteln.

Ein Ausführungsbeispiel der Erfindung ist in der Zeichnung dargestellt.

Fig. 1 zeigt die Außenansicht einer Ohrmuschel mit angeklemmtem Mikrophon und einem in den äußeren Gehörgang zurückführenden Hörschlauch,

Fig. 2 die Rückansicht der vom Schädel losgetrennten Ohrmuschel mit dem die Batterie, den Verstärker und das Telephon enthaltenden Gehäuse,

Fig. 3 einen von vorn gesehenen, durch den äußeren Gehörgang geführten Längsschnitt,

Fig. 4 eine Rückansicht des ganzen Schwerhörigengeräts und

Fig. 5 eine Draufsicht auf dieses Gerät ohne den Hörschlauch.

Das Mikrophon 10 ist unter Zwischenschaltung einer schallisolierenden Schaumstoffschicht 11 in ein möglichst flaches, z. B. knopfförmiges Gehäuse 12 vor-

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zugsweise aus thermoplastischem Kunststoff eingebettet. Das Mikrophongehäuse 12 ist auf seiner der Ohrmuschel 13 zugekehrten Rückseite mit einer der Ohrmuschelwölbung angepaßten konvexen Anlagefläche 14 und an ihrem Rand mit einem vorspringenden Wulst 15 versehen, welcher in die Hohlkehle der nach innen umgebogenen Ohrmuschelleiste 16 greift, um dem Mikrophongehäuse 12 einen sicheren Halt zu geben. In der nach außen gekehrten Vorderfläche des Mikrophongehäuses 12 ist die zum Mikrophon 10 führende Schallöffnung 17 vorgesehen.

Durch diese Anordnung des Mikrophongehäuses 12 und seiner Schallöffnung 17 wird erreicht, daß jedes Geräusch in der gleichen Weise geortet aufgenommen wird wie durch das natürliche Ohr. Gleichzeitig wird aber auch der weitere sehr wichtige Vorteil erzielt, daß jede Übertragung der eigenen Sprache des Benutzers durch Knochenleitung auf das Mikrophon verhindert wird.

Das Mikrophongehäuse 12 ist an dem vorderen, d. h. auf der Außenseite der Ohrmuschel 13 liegenden Ende eines Klemmbügels 18 angeordnet, der U-förmig gebogen ist und an seinem hinteren, d. h. hinter der Ohrmuschel 13 liegenden Ende das ungefähr nierenförmige, flache Gehäuse 19 trägt. In diesem Gehäuse 19 ist die Batterie 20, der Verstärker 21 und das Telephon 22 untergebracht (Fig. 2). Die zum Mikrophon 10 führenden elektrischen Leitungen 23 sind in den Klemmbügel 18 eingebettet. Sie können aus einem federelastischen Werkstoff bestehen, um die Klemmwirkung des Bügels 18 zu unterstützen. An dem Teil des Gerätegehäuses 19, welcher dem Mikrophongehäuse 12 gegenüberliegt, kann eine Mulde 24 vorgesehen sein, welche der kuppenförmigen Anlagefläche 14 des Mikrophongehäuses 12 entspricht. Das Mikrophongehäuse 12 und der ihm gegenüberliegende Teil des Gerätegehäuses 19 bilden also zusammenwirkende

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909 767/[illegible]

…which receives the parts of the instrument, such as

Klemmbacken, welche die Ohrmuschel zwischeneinander erfassen. Ferner können an dem Gerätegehäuse 19 noch Griffe 25 zum Ein- und Ausschalten des Batteriestroms bzw. für das Einstellen der Klangfarbe und Lautstärke vorgesehen sein.

Von dem bei der Benutzung des Hörgeräts nach unten gerichteten Ende des Gerätegehäuses 19 geht ein Hörschlauch 26 aus, der mit einem in den äußeren Gehörgang 27 hineinzusteckenden Paßstück 23 versehen ist und unter dem unteren Ansatz der Ohrmuschel hindurch nach vorn geführt wird.

Bei der Benutzung des beschriebenen Schwerhörigengeräts wird zuerst das Mikrophongehäuse 12 in die Ohrmuschel 13 eingesetzt und dann das Gerätegehäuse 19 durch Schwenken des Klemmbügels 18 hinter die Ohrmuschel gebracht. Dabei legt sich der Klemmbügel 18 über die obere An[illegible]stelle der Ohrmuschel am Schädel.

In dieser Lage wird das Hörgerät durch [illegible] Klemmwirkung des Bügels 18 an der Ohrmuschel festgehalten. Dann wird der Hörschlauch 26 um den unteren Ansatz der Ohrmuschel nach vorn geführt und das Ohrpaßstück 23 in den äußeren Gehörgang 27 gesteckt.

Das Mikrophongehäuse 12 und das Gerätegehäuse 19 sowie der Klemmbügel 18 bestehen vorzugsweise aus einem thermoplastischen Kunststoff. Sie können dann entweder als ein einziges, zusammenhängendes Stück hergestellt oder miteinander verschweißt werden. Außerdem ist es leicht möglich, den Klemmbügel in erwärmtem Zustand in die jeweils richtige Form zu bringen, während er nach dem Erkalten eine für das Festklemmen des Geräts an der Ohrmuschel ausreichende Federkraft aufweist.

Die einzelnen Teile des Geräts, wie Mikrophongehäuse 12, Klemmbügel 18 und Gerätegehäuse 19, können aber auch leicht lösbar miteinander verbunden werden, damit man durch Zusammenstellen geeignet bemessener oder gestalteter Normteile jeweils die für den Benutzer günstigste Kombination bilden kann.

Das Mikrophongehäuse 12 könnte an dem Klemmbügel 18 auch in solcher Weise angeordnet werden, daß es unmittelbar vor dem Eingang zum äußeren Gehörgang 27 liegt. Diese Anordnung hätte jedoch den Nachteil, daß der Klemmbügel sehr sichtbar würde und [illegible] über den Hörschlauch eine Rückkopplung unter Umständen zwischen Telephon und Mikrophon entstehen könnte.

Patentansprüche:

1. Hörgerät für Schwerhörige, dessen hinter der Ohrmuschel liegendes Gerätegehäuse von einem über den oberen Ansatz der Ohrmuschel hinweggreifenden Bügel getragen wird und bei dem das im Gerätegehäuse angeordnete Telephon durch einen Hörschlauch mit einem in den äußeren Gehörgang hineinzusteckenden Ohrpaßstück verbunden ist, dadurch gekennzeichnet, daß das Mikrophon (10) an dem auf der Vorderseite der Ohrmuschel anliegenden Ende des Tragbügels (18) angeordnet ist.

2. Hörgerät nach Anspruch 1, dadurch gekennzeichnet, daß das als Mikrophongehäuse (12) ausgebildete Ende des Bügels (18) und das am anderen Ende des Bügels angeordnete Gerätegehäuse (19) als der Ohrmuschel angepaßte, zusammenwirkende Klemmbacken ausgebildet sind.

3. Hörgerät nach Anspruch 2, dadurch gekennzeichnet, daß das Mikrophongehäuse (12) mit einer gegen die Außenseite der Ohrmuschel gerichteten kuppenförmigen Anlagefläche (14) und der ihr auf der Rückseite der Ohrmuschel gegenüberliegende Teil des Gerätegehäuses (19) mit einer entsprechenden muldenförmigen Vertiefung [illegible] versehen ist.

4. Hörgerät nach Anspruch [illegible], dadurch gekennzeichnet, daß der der Ohrmuschelleiste [illegible] zugekehrte Teil des Mikrophongehäuses (12) mit einem nach außen vorspringenden [illegible] versehen ist, der beim Gebrauch des Geräts in die Hohlkehle der nach innen umgebogenen Ohrmuschelleiste greift.

In Betracht gezogene Druckschriften:
Deutsches Gebrauchsmuster Nr. 1 735 662;
österreichische Patentschrift Nr. 194 933.

Hierzu 1 Blatt Zeichnungen

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…which receives the parts of the instrument, such as

Federal Republic of Germany

German Patent Office

Provisional Patent 1,078,175

Class 21 a² 17/03
Internat. Cl. H 04 m

M 38559 VIIIa/21 a²

Filing date: August 8, 1958

Application made public and prov. patent issued: March 24, 1960

Hearing aid to be worn behind the ear

Applicant: micro-technic Hüber & Co., Stuttgart-Degerloch, Löwenstr. 94

Walter Hüber, Stuttgart-Degerloch, has been named as the inventor

The invention relates to those hearing aids for the hard-of-hearing whose bean- or kidney-shaped instrument housing, lying behind the auricle, is supported by a yoke engaging over the upper attachment of the auricle.

In known hearing aids of this kind, the microphone is arranged in the housing to be worn behind the ear. The disadvantage of this is that the sound waves picked up in natural hearing from the outside of the auricle and conducted to the outer aural passage can reach the microphone only by the detour around the edge of the auricle and cause acoustic effects differing from natural hearing.

It is further known how to arrange the microphone at the outer end and the telephone at the inner end of an ear-piece to be inserted into the outer aural passage and receiving in itself at the same time the amplifier and the battery thereof. However, with this solution there result, due to the close proximity between the microphone and the telephone, disturbing feedback phenomena which prevent distinct hearing.

The invention consists in that the microphone is arranged at the end - applying against the front of the auricle - of the supporting yoke engaging over the auricle attachment, while the telephone is arranged in the lower part of the housing lying behind the auricle and is connected with the ear-piece by a hearing tube engaging around the lower auricle attachment, in known manner. It is thus achieved that the acoustic effects caused by the form of the auricle are made use of at least in part for the sound pick up of the microphone and convey sound impressions coming close to natural hearing.

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An embodiment of the invention is illustrated in the drawing.

Fig. 1 shows the external view of an auricle, and a haring tube leading back into the outer aural passage;

Fig. 2, the rear view of the auricle detached from the skull, with the housing containing the battery, the amplifier, and the telephone;

Fig. 3, a longitudinal section seen from the front, through the outer aural passage;

Fig. 4, a rear view of the entire hearing aid; and

Fig. 5, a top view of this instrument without the hearing tube.

The microphone 10 is embedded, with interposition of a sound-insulating foam layer 11, into as flat as possible a housing 12, e.g. button-shaped, preferably of thermoplastic material. The microphone housing 12 is provided on its back turned toward the auricle 13 with a convex bearing surface 14 adapted to the arc of the auricle and, on the edge of said surface, with a projecting bead 15 which engages into the fillet of the inwardly bent auricle edge 16, in order to give the microphone housing 12 a secure hold. In the outwardly turned front face of the microphone housing 12 there is provided the sound opening 17 leading to the microphone 10.

By this arrangement of the microphone housing 12 and its sound opening 17 it is achieved that every noise is picked up located in the same manner as by the natural ear. At the same time, the additional very important advantage is achieved that any transmission of the user's own speech through bone conduction to the microphone is prevented.

The microphone housing 12 is arranged on the front end - i.e. the end lying on the exterior of the auricle 13 - of a clamping yoke 18, which is bent in U form and carries the approximately kidney-shaped flat housing 19 at its rear end, i.e. the end lying behind the auricle 13. In this housing 19 is lodged the battery 20, the amplifier 21 and the telephone 22 (Fig. 2). The electric lines 23 leading to the microphone 10 are embedded in the clamping yoke 18. They may be made of a spring-elastic material, to support the clamping effect of yoke 18. At the portion of the instrument housing 19 located opposite the microphone housing

12, a depression 24 may be provided which matches the dome-shaped bearing face 14 of the microphone housing 12. The microphone housing 12 and the portion of the instrument housing 19 opposite it therefore form cooperating clamping cheeks, which grip the auricle between them. On the instrument housing 19 may be provided further knobs 25 for switching the battery current on and off and for adjusting the tone quality and volume.

From the end of the instrument housing 19 directed downward when the hearing aid is in use there extends a hearing tube 26 which is provided with an earpiece 28 to be inserted into the outer aural passage 27 and is brought forward under the attachment of the auricle.

When using the described hearing aid, first the microphone housing 12 is inserted into the auricle 13 and then the instrument housing 19 is brought behind the auricle by pivoting yoke 18. In so doing the clamping yoke 18 places itself over the upper attachment point of the auricle to the skull.

In this position the hearing aid is retained at the auricle by the clamping effect of yoke 18. Then the hearing tube 26 is brought forward around the lower attachment of the auricle and the ear-piece 28 is inserted into the outer aural passage 27.

The microphone housing 12 and the instrumenthousing 19 as well as the clamping yoke 18 consist preferably of a thermoplastic material. They may then be produced either as a single, continuous piece, or be welded together. Besides, it is easily possible to bring the clamping yoke into the correct form in the heated state, while after cooling it has sufficient spring force for clamping the instrument on the auricle.

The individual parts of the instrument, such as microphone housing 12, clamping yoke 18 and instrument housing 19, may alternatively be connected together for easy detachment, so that by combining suitably dimensioned or shaped standard parts one can form the combination most favorable for the user.

Another possibility would be to arrange the microphone housing 12 at the clamping yoke 18 in such a way that it lies directly in front of the entrance to the

outer aural passage 27. However, this arrangement would have the disadvantage that the clamping yoke would become very visible and that possibly a feedback between telephone and microphone could result via the hearing tube.

Claims

1. Hearing aid for the hard-of-hearing, whose instrument housing, lying behind the auricle, is supported by a yoke engaging over the upper attachment of the auricle, is supported by a yoke engaging over the upper attachment of the auricle and where the telephone arranged in the instrument housing is connected with an ear-piece to be inserted into the outer aural passage through a hearing tube, characterized in that the microphone (10) is arranged at the end of the supporting yoke (18) applying against the front of the auricle.

2. Hearing aid according to claim 1, characterized in that the end of the yoke (18) designed as microphone housing (12) and the instrument housing (19) arranged at the other end of the yoke are designed as cooperating clamping cheeks adapted to the auricle.

3. Hearing aid according to claim 2, characterized in that the microphone housing (12) is provided with a dome-shaped bearing face (14) dorected against the outer side of the auricle and the part of the instrument housing (19) opposite it on the back of the auricle with a corresponding bowl-shaped depression (24).

4. Hearing aid according to claim 1, characterized in that the part of the microphone housing (12) turned toward the auricle edge (16) is provided with an outwardly projecting bead (15), which engages into the fillet of the inwardly bent auricle edge when the instrument is in use.

Publications taken into consideration: German Utility Model No. 1,735,662; Austrian Patent No. 194,933.

One sheet of drawings annexed.

Translated by Carl Demrick Associates, Inc./LM/db

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ZEICHNUNGEN BLATT 1

AUSGABETAG: 15. NOVEMBER 1962

DAS 113? 549
KL. 21 a² 17/03
INTERNAT. KL. H 04 m

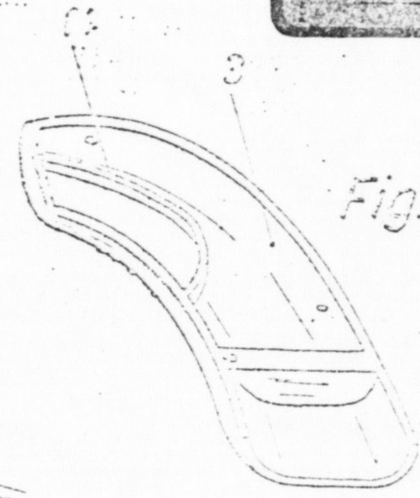

Fig.3

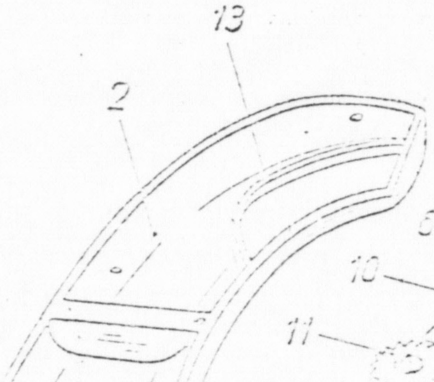

Fig.1

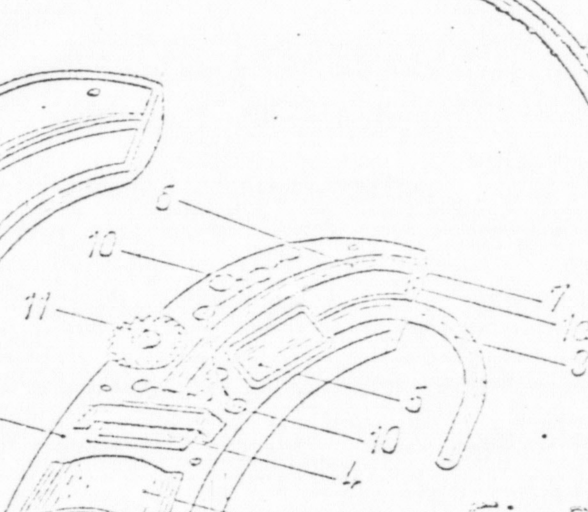

Fig.2

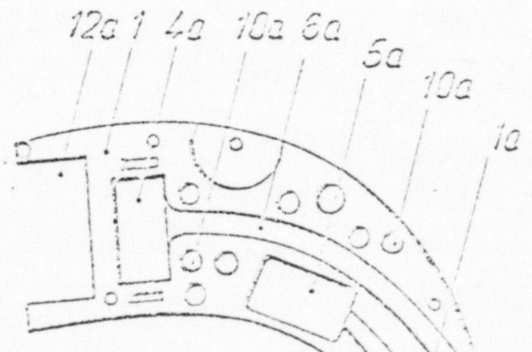

Fig.4

Ex. 82 336

BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

KL. 21 a² 17/03

INTERNAT. KL. H 04 m

AUSLEGESCHRIFT 1 139 549

D 36342 VIIIa/21a²

ANMELDETAG: 16. JUNI 19..

BEKANNTMACHUNG
DER ANMELDUNG
UND AUSGABE DER
AUSLEGESCHRIFT: 15. NOVEMBER 19..

Hinter dem Ohr zu tragendes Schwerhörigengerät

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ist als Erfinder genannt worden

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Die Erfindung betrifft ein hinter dem Ohr zu tragendes Schwerhörigengerät, bestehend aus einem etwa sichel- oder halbmondförmigen Gehäuse, das die Teile des Gerätes, wie Mikrophon, Verstärker, Hörer, Batterie usw., aufnimmt und in seinem oberen, beim Tragen über dem Ohr liegenden Ende eine Schalleintrittsöffnung für das Mikrophon trägt. Ein derartiges Gerät wirkt recht unauffällig beim Tragen, weil es infolge seiner kleinen, dem Raum hinter der Ohrmuschel angepaßten sichelförmigen Gestalt zum größten Teil durch die Ohrmuschel verdeckt wird. Sichtbar für einen davorstehenden Partner bleibt lediglich oberhalb des Ohres das obere Ende des sichelförmigen Gehäuses sowie der hier austretende und zur Ohröffnung führende Hörschlauch.

Man ist selbstverständlich bestrebt, das Gerät möglichst klein und unauffällig zu machen. Dieses gilt besonders für die beiden vorhin genannten sichtbaren Teilen. Bei der Ausbildung des oberen Endes des sichelförmigen Gehäuses muß man aber auch die akustischen Belange des Gerätes berücksichtigen. Es hat sich nämlich herausgestellt, daß es akustisch günstiger ist, wenn man die Schalleintrittsöffnung für das Mikrophon am oberen Ende des sichelförmigen Gehäuses, und zwar nach vorn gerichtet, anordnet. Einen anderen Platz für die Schalleintrittsöffnung vorzusehen, wie z. B. am unteren Teil des sichelförmigen Gehäuses entweder an dessen unterer Stirnfläche oder an der nach außen liegenden Seitenfläche, ist sehr ungünstig, weil dann die Ohrmuschel die Schalleintrittsöffnung gegen die von vorne kommenden Schallereignisse abschirmt. Dadurch wird der Schwerhörige verwirrt, weil er nicht mehr das richtige Empfinden dafür hat, aus welcher Richtung der Schall kommt.

Es erscheint also auf Grund vorstehender Erkenntnisse empfehlenswert, die Schalleintrittsöffnung für das Mikrophon an das obere Ende des sichelförmigen Gehäuses zu legen. Dann müßte man aber auch das Mikrophon selber unmittelbar anschließend an die Schalleintrittsöffnung anordnen, damit man entsprechend der bis jetzt herrschenden Auffassung keine zusätzlichen Verluste an Schallenergie in dieser Schallführung in Kauf zu nehmen braucht. Dies bedeutet aber, daß das obere Ende des sichelförmigen Gehäuses plump, also auffällig wird, was aber gerade vermieden werden sollte.

Aus der Schwierigkeit, daß bei Anordnung der Schalleintrittsöffnung mit anschließendem Mikrophon im oberen Teil des Gehäuses einem akustischen Vorteil ein baulicher Nachteil gegenübersteht und umgekehrt, daß man es bei Anordnung der beiden frag-

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lichen Bauteile, nämlich Mikrophon und Schalleintrittsöffnung, an einer anderen Stelle des Gehäuses mit einem baulichen Vorteil gegenüber einem akustischen Nachteil zu tun hat, gibt es einen Ausweg, wenn man gemäß der Erfindung das Mikrophon in dem Gehäuse so weit entfernt von der Schalleintrittsöffnung anordnet, daß zwischen dem Mikrophon und der Schalleintrittsöffnung vorhandener Raum für die Unterbringung anderer Teile des Gerätes, z. B. des Hörers und/oder der Schaltelemente des Verstärkers, ausgenutzt wird, und man das Mikrophon mit der Schalleintrittsöffnung durch eine als Schallführung dienende Schlauchleitung verbindet.

Es hat sich nämlich herausgestellt, daß entgegen der bisherigen Auffassung durch die Einfügung einer Schlauchleitung zwischen Mikrophon und Schalleintrittsöffnung durchaus keine Übertragungsverluste der Schallenergie eintreten, sondern daß im Gegenteil sowohl die Empfindlichkeit des Gerätes größer wird als auch die Frequenzdurchlaßkurve besser liegt. Der Erfinder konnte bisher nicht mit Sicherheit feststellen, worauf diese Verbesserung der akustischen Verhältnisse zurückzuführen ist. Möglicherweise beruht sie auf der an und für sich bekannten Tatsache, daß es günstiger ist, den Luftraum innerhalb des Mikrophons erst mit dem Luftraum der Schlauchleitung in Wechselwirkung treten zu lassen, als daß man bei Fehlen der Schlauchleitung den Luftraum des Mikrophons unmittelbar mit dem unendlich großen Luftraum der Umgebung in Verbindung bringt.

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Man kann nunmehr ohne weitere Nachteile die Schalleintrittsöffnung an das obere Ende des sichelförmigen Gehäuses legen, ohne daß man das Mikrophon direkt daneben, also ebenfalls am oberen Ende unterbringen muß; man hat es dadurch in der Hand, das obere Ende des Gehäuses, das sich ja oberhalb des Ohres befindet und deutlich sichtbar ist, sehr schlank und unauffällig zu machen. Darüber hinaus wird die Charakteristik des Mikrophons eindeutig verbessert.

Hat man einmal festgestellt, daß bestimmte, zunächst aus räumlichen Gründen projektierte Abmaße der Schlauchleitung zwischen Mikrophon und Schalleintrittsöffnung akustisch günstig sind, so spielt die Lage dieser Schlauchleitung keine ausschlaggebende Rolle. Die Leitung kann nach einem Merkmal der Erfindung entweder vollständig im Inneren des Gehäuses verlaufen oder wenigstens teilweise auf der Außenseite des Gehäuses.

Bei der Festlegung der Abmaße für die Schlauchleitung, wie Länge und Querschnitt, ist aber auch die Formgebung der am offenen Ende dieser Schlauchleitung befindlichen Schalleintrittsöffnung zu berücksichtigen. Je nach den durch die [illegible] der Lufträume im Mikrophon und in der Schlauchleitung bedingten akustischen Verhältnissen kann es zweckmäßig sein, das offene Ende der Schlauchleitung unmittelbar die Schalleintrittsöffnung bilden zu lassen, wobei die Öffnung einen im wesentlichen mit der übrigen Schlauchleitung übereinstimmenden Querschnitt haben kann, oder man kann das offene Ende der Schlauchleitung trichterförmig oder in ähnlicher Weise erweitern. Unter Umständen und entgegen aller Erwartung kann sogar eine Verengung von Nutzen sein.

Der Träger des Schwerhörigengerätes, dessen Schalleintrittsöffnung oberhalb des Ohres liegt, wird nur dann ein dem natürlichen Hören angenähert entsprechendes Richtungsempfinden haben, wenn nach einem Merkmal der Erfindung die Richtung der von dem offenen Ende der Schlauchleitung gebildeten Schalleintrittsöffnung beim Tragen des Gerätes hinter dem Ohr mit der normalen Blickrichtung des Trägers einen Winkel von weniger als 30 Grad einschließt.

Dadurch, daß das Schwerhörigengerät hinter dem Ohr eine bestimmte Lage hat und in dieser Lage durch den Hörschlauch gehalten wird, der von dem in dem sichelförmigen Gehäuse eingebauten Hörer kommend dieses Gehäuse in seinem oberen Teil verläßt und zu dem in den Gehörgang eingesteckten Ohrstück führt, ist auch die Einhaltung der einmal für die Schalleintrittsöffnung als günstig erkannten Richtung, nämlich der normalen Blickrichtung des Trägers, gewährleistet.

Es ist bekannt, ein hinter dem Ohr zu tragendes Schwerhörigengerät so aufzubauen, daß es aus drei Baugruppen besteht, nämlich einem plattenförmigen Mittelteil, das mit Bohrungen und Ausnehmungen zur Aufnahme der Teile des Gerätes versehen ist, und zwei, auf die beiden Flächen des Mittelteiles aufgesetzten Deckschalen. Diese Anordnung hat sich sehr bewährt und kann auch zur Durchführung des Erfindungsgedankens beibehalten werden. Zur Aufnahme der Schlauchleitung zwischen Mikrophon und Schalleintrittsöffnung kann vorteilhafterweise auf einer Fläche des plattenförmigen Mittelteiles eine Rinne vorgesehen werden.

Damit innerhalb des von dem Gehäuse umschlossenen Raumes die vom Hörer abgestrahlte Schallenergie nicht ungünstig auf das Mikrophon einwirkt, ist nach einem weiteren Merkmal der Erfindung zwischen den beiden Flächen des plattenförmigen Mittelteiles einerseits und der Innenseite der Deckschalen andererseits mindestens je eine den Hörer vom Mikrophon trennende Dichtung angebracht, die den vom Hörer abgestrahlten Luftschall in einem solchen Maße von dem Mikrophon fernhält, daß ein selbständiges Anschwingen oder eine Selbsterregung des Gerätes nicht eintreten kann.

Um die volle Verstärkung des Gerätes ausnutzen zu können, dürfen vom Hörer keine Schallwellen direkt auf das Mikrophon gelangen. Die Abdichtung muß also möglichst wirksam sein und kann zweckmäßigerweise durch an der Innenseite der Deckschalen und/oder auf dem plattenförmigen Mittelteil angeformte Rippen gebildet werden. Statt der Rippen kann auch schalldämpfendes Material genommen werden, das zwischen das plattenförmige Mittelteil und die Deckschalen gelegt ist. Natürlich kann man auch beides kombinieren und bei Anordnung von Rippen den etwa noch vorhandenen Luftspalt durch schalldämpfendes Material ausfüllen.

Weitere Einzelheiten der Erfindung seien an Hand der Zeichnungen erläutert, die in vergrößertem Maßstab ein Ausführungsbeispiel des Gerätes darstellen.

Fig. 1 bringt eine perspektivische Ansicht der unteren Deckschale, die vom plattenförmigen Mittelteil abgenommen und umgelegt ist.

Fig. 2 gibt in perspektivischer Ansicht das plattenförmige Mittelteil mit sämtlichen Einbauteilen wieder.

Fig. 3 ist eine perspektivische Ansicht der oberen Deckschale, vom plattenförmigen Mittelteil abgehoben und umgeklappt.

Fig. 4 zeigt das plattenförmige Mittelteil, die Einbauteile herausgenommen.

Das hinter dem Ohr zu tragende Schwerhörigengerät wird nach außen begrenzt durch die beiden Deckschalen 2, 3, deren Form aus den Fig. 1 bzw. 3 zu ersehen ist, ferner durch drei Seitenflächen des plattenförmigen Mittelteiles 1, dessen oberes Ende 1a in der Gebrauchslage des Gerätes ungefähr senkrecht steht, und schließlich durch die am unteren Ende des plattenförmigen Mittelteiles schwenkbar angebrachte Abschlußklappe 9 für die Batterie 12. Die beiden Deckschalen können mittels mehrerer Schrauben auf den beiden Flächen des plattenförmigen Mittelteiles befestigt werden.

In den Ausnehmungen und Bohrungen des plattenförmigen Mittelteiles 1 sind die Teile des Gerätes untergebracht und untereinander mit Leitungen verbunden, die beim Aufsetzen der beiden Deckschalen 2, 3 in deren Hohlräumen Platz finden.

Im einzelnen ist in der Ausnehmung 4a das Mikrophon 4 mittels eines Gummibandes elastisch aufgehängt und mit der in der Rinne 6a ruhenden Schlauchleitung 6 verbunden, deren anderes Ende die Schalleintrittsöffnung 7 bildet. Diese ist im vorliegenden Ausführungsbeispiel einfach das offene Ende der Schlauchleitung.

In der Ausnehmung 5a ist auf in der Zeichnung nicht dargestellte Weise der Hörer 5 befestigt, dessen Schallenergie über den Hörschlauch 8 in das Ohr geführt wird. In den Bohrungen 10a des plattenförmigen Mittelteiles 1 finden die elektrischen Teile 10 des Verstärkers, wie z. B. Widerstände, Konden-

sätören usw., Aufnahme. In der Ausnehmung 12*a* ist die Batterie 12 untergebracht, und für den Lautstärkeregler 11 ist eine flache Mulde in dem plattenförmigen Mittelteil vorgesehen.

Die auf den Deckschalen 2, 3 angebrachten Abdichtungsrippen 13, 14 liegen beim Aufsetzen der Deckschalen auf den Flächen des plattenförmigen Mittelteiles direkt auf und halten die Schallwellen des Hörers 5 vom Mikrophon 4 fern.

Selbstverständlich ist die Erfindung nicht auf das dargestellte und erläuterte Ausführungsbeispiel beschränkt, sondern kann grundsätzlich auch auf alle anderen, für hinter dem Ohr zu tragende Bauformen verwendet werden.

PATENTANSPRÜCHE:

1. Hinter dem Ohr zu tragendes Schwerhörigengerät, bestehend aus einem etwa sichel- oder halbmondförmigen Gehäuse, das die Teile des Gerätes, wie Mikrophon, Verstärker, Hörer, Batterie usw., aufnimmt und in seinem oberen, beim Tragen über dem Ohr liegenden Ende eine Schalleintrittsöffnung für das Mikrophon trägt, dadurch gekennzeichnet, daß das Mikrophon in dem Gehäuse so weit entfernt von der Schalleintrittsöffnung angeordnet ist, daß zwischen dem Mikrophon und der Schalleintrittsöffnung vorhandener Raum für die Unterbringung anderer Teile des Gerätes, z. B. des Hörers und/oder der Schaltelemente des Verstärkers, ausgenutzt wird, und daß das Mikrophon mit der Schalleintrittsöffnung durch eine als Schallführung dienende Schlauchleitung verbunden ist.

2. Schwerhörigengerät nach Anspruch 1, dadurch gekennzeichnet, daß die Schlauchleitung vollständig im Innern des Gehäuses verläuft.

3. Schwerhörigengerät nach Anspruch 1, dadurch gekennzeichnet, daß die Schlauchleitung wenigstens teilweise auf der Außenseite des Gehäuses verläuft.

4. Schwerhörigengerät nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß das offene Ende der Schlauchleitung unmittelbar die Schalleintrittsöffnung ist.

5. Schwerhörigengerät nach Anspruch 4, dadurch gekennzeichnet, daß das als Schalleintrittsöffnung dienende offene Ende der Schlauchleitung einen im wesentlichen mit der übrigen

Schlauchleitung übereinstimmenden Querschnitt hat.

6. Schwerhörigengerät nach Anspruch 4, dadurch gekennzeichnet, daß das offene Ende der Schlauchleitung gegenüber der übrigen Schlauchleitung trichterförmig oder in ähnlicher Weise erweitert ist.

7. Schwerhörigengerät nach Anspruch 4, dadurch gekennzeichnet, daß das offene Ende der Schlauchleitung etwas verengt ist.

8. Schwerhörigengerät nach einem oder mehreren der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß die Richtung der von dem offenen Ende der Schlauchleitung gebildeten Schalleintrittsöffnung beim Tragen des Gerätes hinter dem Ohr mit der normalen Blickrichtung des Trägers einen Winkel von weniger als 30° einschließt.

9. Schwerhörigengerät nach einem oder mehreren der Ansprüche 1 bis 8, bestehend aus drei Baugruppen, nämlich einem plattenförmigen Mittelteil, das mit Bohrungen und Ausnehmungen zur Aufnahme der Teile des Gerätes versehen ist, und aus zwei auf die beiden Flächen des Mittelteiles aufgesetzten Deckschalen, dadurch gekennzeichnet, daß auf einer Fläche des plattenförmigen Mittelteiles eine Rinne zur Aufnahme der Schlauchleitung vorgesehen ist.

10. Schwerhörigengerät nach Anspruch 1 bis 3 und 9, dadurch gekennzeichnet, daß zwischen den beiden Flächen des plattenförmigen Mittelteiles einerseits und der Innenseite der Deckschalen andererseits mindestens je eine den Hörer vom Mikrophon trennende Dichtung angebracht ist, die den vom Hörer abgestrahlten Luftschall in einem solchen Maß vom Mikrophon fernhält, daß ein selbsterregtes Anschwingen oder eine Selbsterregung des Gerätes nicht eintreten kann.

11. Schwerhörigengerät nach Anspruch 10, dadurch gekennzeichnet, daß die Dichtung durch an der Innenseite der Deckschalen und/oder auf dem plattenförmigen Mittelteil angeformte Rippen gebildet ist.

12. Schwerhörigengerät nach Anspruch 10, dadurch gekennzeichnet, daß die Dichtung durch zwischen das plattenförmige Mittelteil und die Deckschalen gelegtes schalldämpfendes Material gebildet ist.

Hierzu 1 Blatt Zeichnungen

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Federal Republic of Germany

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Hearing aid to be worn behind the ear

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The invention relates to a hearing aid to be worn behind the ear, consisting of a more or less sickle- or crescent-shaped housing, which receives the parts of the instrument such as microphone, amplifier, earphone, battery, etc., and carries its upper end, lying over the ear when the instrument is worn, a sound inlet opening for the microphone. Such an instrument is quite inconspicuous when worn because, due to its small, sickle-shaped form adapted to the space behind the auricle, it is covered for the most part by the auricle. Visible to a partner standing in front is only, above the ear, the upper end of the sickle shaped housing as well as the bearing tube emerging therefrom and leading to the ear opening.

Naturally one tries to make the instrument as small and inconspicuous as possible. This applies in particular to the two visible portions just mentioned. In the design of the upper end of the sickle-shaped housing, however, one must take into consideration also the acoustic factors of the housing. It has in fact been found that it is acoustically more favorable to arrange the sound inlet opening for the microphone at the upper end of the sickle-shaped housing, namely directed forward. To provide a different place for the sound inlet opening, as for example at the lower part of the sickle-shaped housing, either at its lower front face or at the lateral face located toward the outside, is very 340 unfavorable because then the auricle shields the sound inlet opening against the

sonic events coming from the front. This confuses the hard-of-hearing, because he no longer has the right feeling what direction the sound comes from.

Because of the above findings, therefore, it appears desirable to place the sound inlet opening for the microphone at the upper end of the sickle-shaped housing. But then it would be necessary also to arrange the microphone itself directly contiguous to the sound inlet opening, in order that, according to the opinion prevailing until now, one does not have to accept additional losses of acoustical energy in this sound conduction. But this means that the upper end of the sickle-shaped housing becomes plump, that is, conspicuous, which is exactly what was to be avoided.

From the difficulty that if the sound inlet opening with following microphone is arranged in the upper part of the housing an acoustical advantage is offset by a structural disadvantage, and conversely, that if the two parts in question, namely microphone and sound inlet opening, are arranged at a different point of the housing one is dealing with a structural advantage opposed by an acoustical disadvantage, there is a way out if according to the invention the microphone in the housing is arranged so far away from the sound inlet opening that space present between the microphone and the sound inlet opening is utilized for the accommodation of other parts of the instrument, e.g. of the earphone and/or the circuit elements of the amplifier, and the microphone is connected with the sound inlet opening by a tube line serving as sound conduction.

It has in fact been found that, contrary to the previous opinion, transmission losses of the acoustical energy do not at all occur by the insertion of a tube line between microphone and sound inlet opening, but that on the contrary the sensitivity of the instrument becomes greater and the frequency transmission curve is better. The inventor has not been able until now to ascertain with certainty what this improvement of the acoustical conditions is attributable to. It may possibly be due to the fact, known in itself, that it is more favorable to let the air space within the microphone interact with the air space of the tube line rather than connecting the air space of the microphone directly with the infinitely large air space of the surrounding when there is no tube line.

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It is now possible without further disadvantages to place the sound inlet opening at the upper end of the sickle-shaped housing without having to arrange the microphone directly alongside, that is, also at the upper end; it is thereby possible to make the upper end of the housing, which is above the ear and is clearly visible, very slender and inconspicuous. Moreover, the characteristic of the microphone is definitely improved.

Once it has been established that certain dimensions of the tube line between microphone and sound inlet opening, which had originally been planned for spatial reasons, are acoustically favorable, the position of this tube line is no longer a decisive factor. The line can, according to a feature of the invention, extend either entirely in the interior of the housing or at least partially on the outside of the housing.

When fixing the dimensions for the tube line, such as length and cross section also the form of the sound inlet opening at the open end of this tube line must be taken into consideration. Depending on the acoustical conditions caused by the size of the air spaces in the microphone and in the tube line, it may be expedient to let the open end of the tube line form the sound inlet opening directly, letting the opening have a cross-section substantially concordant with the rest of the tube line, or the open end of the tube line may be widened like a funnel or in a similar manner. Sometimes, contrary to all expectation, even a constriction may be of advantage.

The wearer of the hearing aid, whose sound inlet opening lies above the ear, will have a directional perception approximately corresponding to natural hearing only if, according to a feature of the invention, the direction of the sound inlet opening formed by the open end of the tube line forms with the wearer's normal viewing direction an angle of less than 30 degrees when the instrument is worn behind the ear.

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Due to the fact that the hearing aid has a certain position behind the ear and is held in this position by the hearing tube which, coming from the earphone installed in the sickle-shaped housing, leaves this housing in its upper part and leads to the ear-piece inserted in the aural passage, also the maintenance of

the direction once found favorable for the sound inlet opening, namely the normal viewing direction of the wearer, is insured.

It is known how to construct a hearing aid to be worn behind the ear so that it consists of three modules, namely a plate-shaped middle part provided with bores and cutouts to receive the parts of the instrument, and two cover shells applied on the two faces of the middle part. This arrangement has proved very successful and can be retained for the practice of the inventive idea. To receive the tube line between microphone and sound inlet opening, a groove may be provided advantageously on one face of the plate type middle part.

In order that the acoustic energy radiated from the earphone within the space enclosed by the housing will not have an adverse effect on the microphone, there is provided between the two faces of the plate-shaped middle part on the one hand and the inside of the cover shells, on the other, according to the invention, at least one seal separating the earphone from the microphone which keeps the air-borne sound radiated from the earphone away from the microphone to such an extent that self-excitation of the instrument or self-buildup cannot occur.

To be able to utilize the full amplification of the instrument, no sound waves must get from the earphone directly to the microphone. The insulation, therefore, must be as effective as possible and can be obtained expediently by ribs molded to the inside of the cover shells and/or on the plate-type middle part. Instead of the ribs, sound-damping material may be taken, placed between the plate type middle part and the cover shells. Naturally, both may be combined, and if ribs are provided, any remaining air gap may be filled up with sound-damping material.

Further details of the invention will now be explained with reference to the drawings, which illustrate on an enlarged scale an embodiment of the instrument.

Fig. 1 gives a perspective view of the lower cover shell, which has been removed from the plate type middle part and placed next to it;

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Fig. 2 gives a perspective view of the plate type middle part with all installation parts;

Fig. 3 is a perspective view of the upper cover shell, lifted off the plate type middle part and flapped over;

Fig. 4 shows the plate type middle part, with the installation parts taken out.

The hearing aid to be worn behind the ear is limited to the outside by the two cover shells 2, 3, the form of which can be seen from Fig. 1 and 3, respectively, further by three side faces of the plate type middle part 1, whose upper end 1a is approximately vertical in the position in which the instrument is used, and finally by the end flap 9 pivotably provided at the lower end of the plate type middle part, for the battery 12. The two cover shells may be secured on the two faces of the plate type middle part by means of several screws.

In the cutouts and bores of the plate type middle part 1 the parts of the instrument are housed and interconnected by lines, which when the two cover shells 2, 3 are placed on, find room in the cavities thereof.

Specifically, in cutout 4a the microphone 4 is elastically suspended by means of a rubber band and connected with the tube line 6 resting in the groove 6a, whose other end forms the sound inlet opening 7. In the present example, the latter is simplk the open end of the tube line.

In a manner not shown in the drawing, there is fastened in the cutout 5a the earphone 5, whose acoustic energy is conducted via the hearing tube 8 into the ear. In the bores 10a of the plate type middle part 1 are received the electrical parts 10 of the amplifier, such as resistors, capacitors, etc. In cutout 12a is lodged the battery 12, and for the volume control 11 a shallow depression is provided in the plate type middle part.

As the cover bowls are applied, the seal ribs 13,14 provided on the cover shells 2, 3 lie on the faces of the plate type middle part directly and keep the sound waves of the earphone 5 away from the microphone 4.

The invention is, of course, not limited to the example of construction illustrated and explained, but canbe used in principle for all other models to be worn behind the ear.

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Claims

1. Hearing aid to be worn behind the ear, consisting of a more or less sickle

or crescent-shaped housing which receives the parts of the instrument, such as microphone, amplifier, earphone, battery, etc. and carries in its upper end, lying above the ear when it is worn, a sound inlet opening for the microphone, characterized in that the microphone is arranged in the housing so far away from the sound inlet opening that space present between the microphone and the sound inlet opening is utilized for the accommodation of other parts of the instrument, e.g. the earphone and/or the circuit elements of the amplifier, and that the microphone is connected with the sound inlet opening by a tube line serving as sound conduction.

2. Hearing aid according to claim 1, characterized in that the tube line extends completely inside the housing.

3. Hearing aid according to claim 1, characterized in that the tube line extends at least in part on the outside of the housing.

4. Hearing aid according to one of claims 1 to 3, characterized in that the open end of the tube line is directly the sound inlet opening.

5. Hearing aid according to claim 4, characterized in that the open end of the tube line serving as sound inlet opening has a cross-section substantially concording with the rest of the tube line.

6. Hearing aid according to claim 4, characterized in that the open end of the tube line is enlarged in relation to the rest of the tube line like a funnel or in a similar way.

7. Hearing aid according to claim 4, characterized in that the open end of the tube line is constricted somewhat.

8. Hearing aid according to one or more of claims 1 to 7, characterized in that the direction of the sound inlet opening formed by the open end of the tube line forms, when the instrument is worn behind the ear, an angle of less than 30° with the wearer's normal viewing direction.

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9. Hearing aid according to one or more of claims 1 to 8, consisting of three modules, namely a plate type middle part, provided with bores and cutouts to receive the parts of the instrument, and two cover shells placed on the two faces of the middle part, characterized in that on one face of the plate type

middle part a groove is provided to receive the tube line.

10. Hearing aid according to claims 1 to 3 and 9, characterized in that between the two faces of the plate type middle part, on the one hand, and the inside of the cover shells, on the other, at least one seal separating the earphone from the microphone is provided, which keeps the air-borne sound radiated from the earphone away from the microphone to such an extent that self-excitation or self-buildup of the instrument cannot occur.

11. Hearing aid according to claim 10, characterized in that the seal is formed by ribs molded on the inner side of the cover shells and/or on the plate type middle part.

12. Hearing aid according to claim 10, characterized in that the seal is formed by damping material placed between the plate type middle part and the cover shells.

One sheet of drawings annexed

Translated by Carl Demrick Associates, Inc./IM/db

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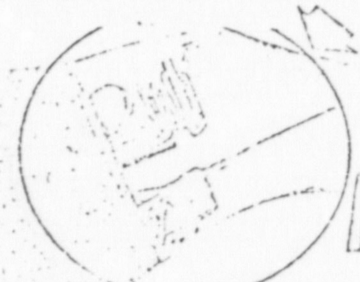

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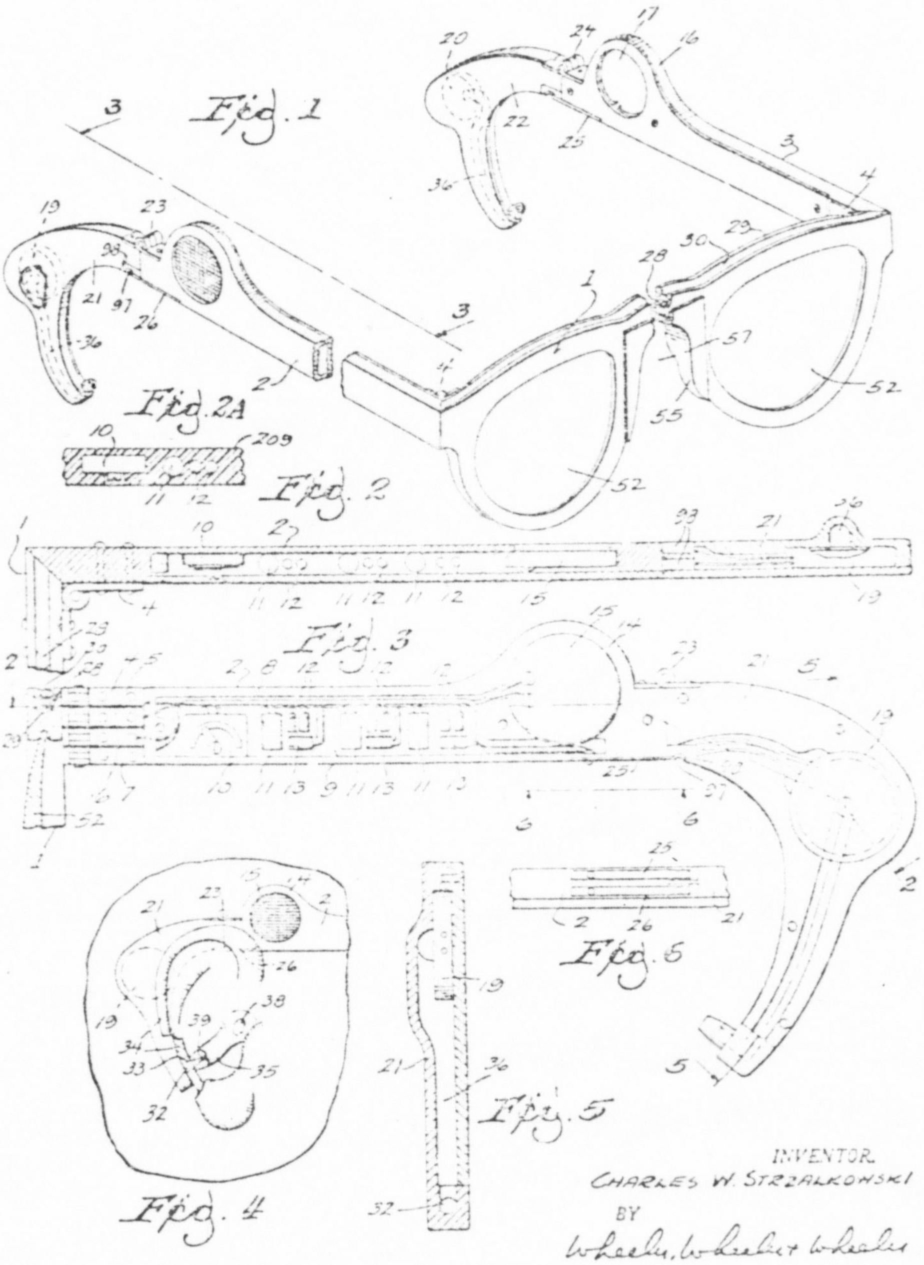
April 1963

May 15, 1962 C. W. STRZALKOWSKI 3,035,127

HEARING AIDS

Filed April 15, 1955 4 Sheets-Sheet 1



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Ex. 90 348

Patented Sept. 15, 1959

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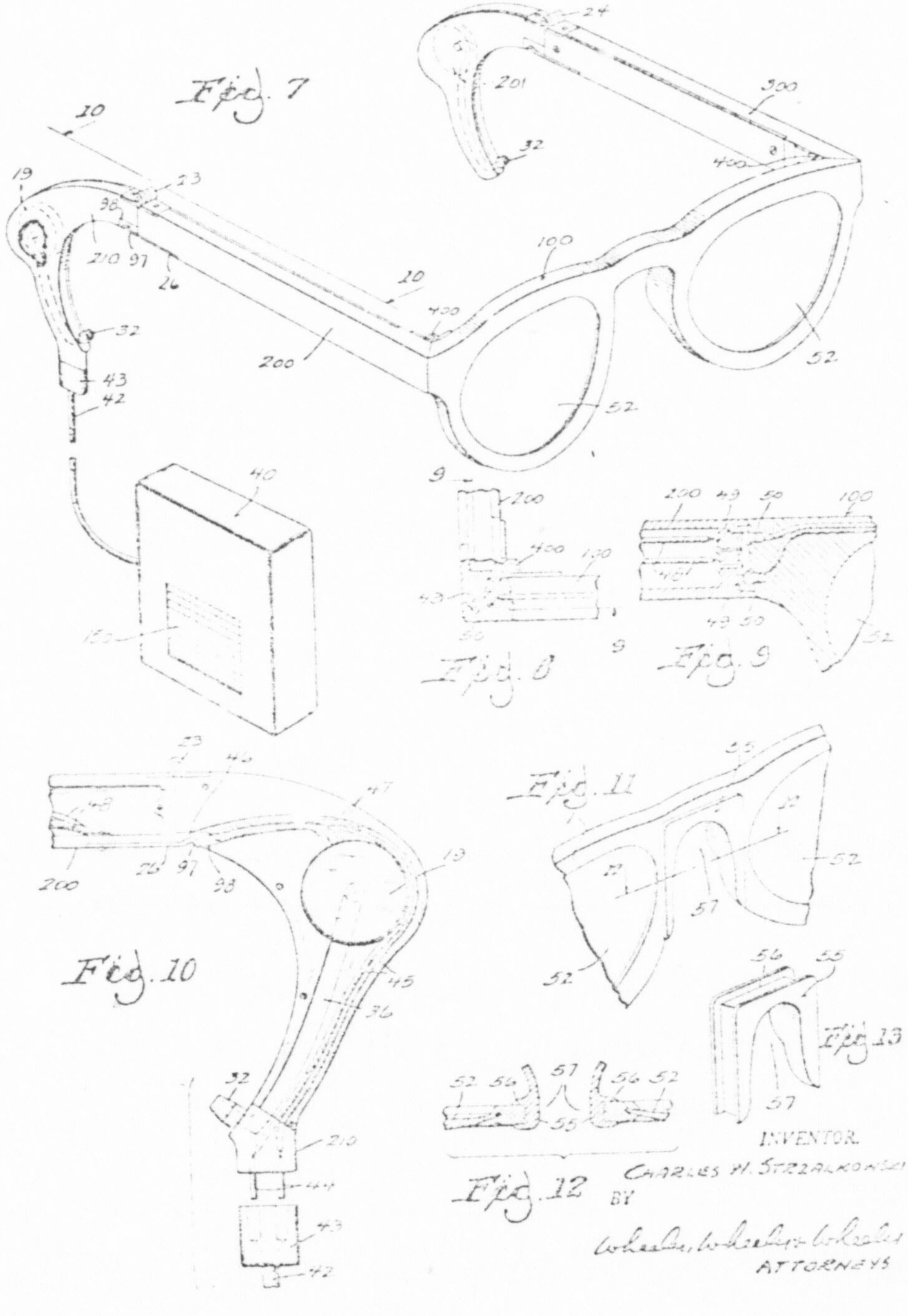
May 15, 1962 C. W. STRZALKOWSKI 3,035,127

HEARING AIDS

Filed April 15, 1955 4 Sheets-Sheet 2



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the end of the canal extension 11 of the body. The body 10 is also formed at its forward end with a relatively small diametered socket 20 communicating with the pas-

of the amplifier A by way of the switch terminals 29 and leads 30 in order that the wearer may listen to incoming radio signals or broadcasts. Merely by manipulating the switch S to connect the transducer 16 to the switch ter-

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HEARING AIDS

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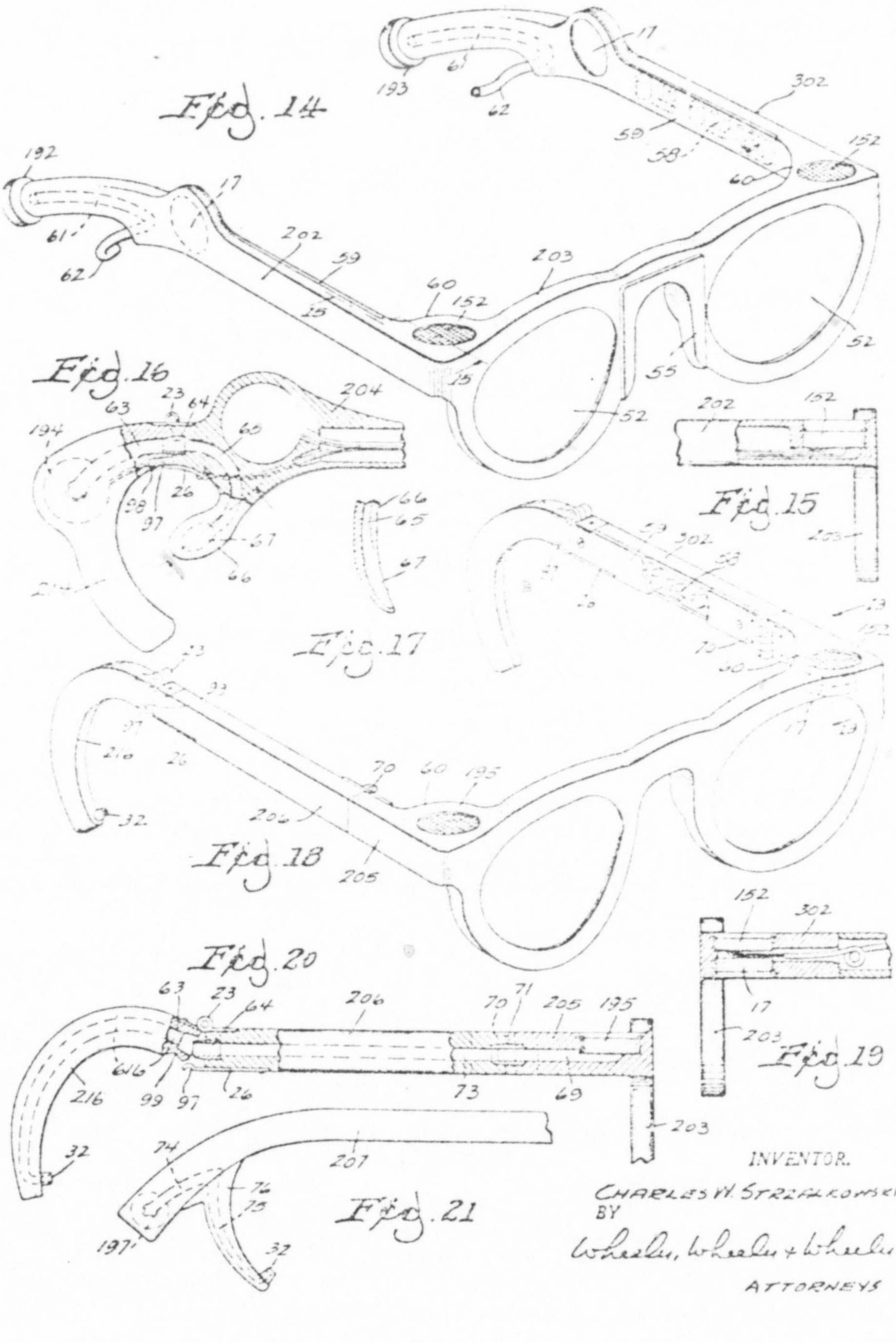

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snugly fit into a human ear and having a passage therein arranged to communicate directly at one end thereof with the canal of an ear into which said body is fitted; a

through said tube to the passage of said body and thence to said transducer.

References Cited in the file of this patent

May 15, 1962 C. W. STRZALKOWSKI 3,035,127

HEARING AIDS

Filed April 15, 1955 4 Sheets-Sheet 4

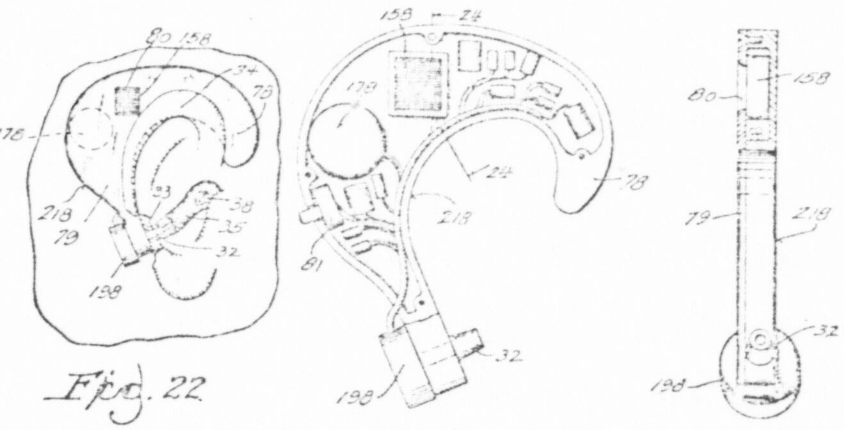

Fig. 22 Fig. 23 Fig. 24

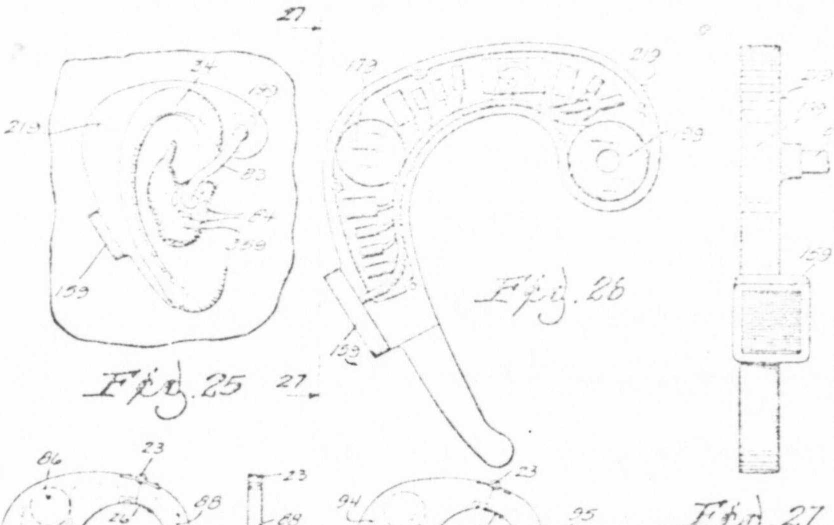

Fig. 25 Fig. 26 Fig. 27

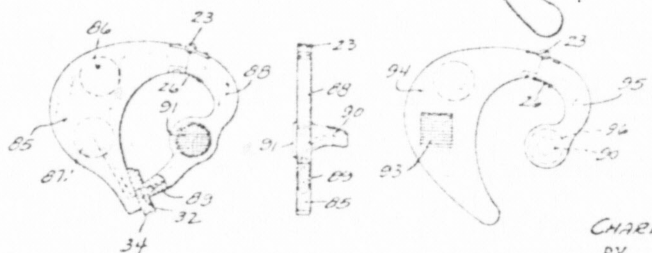

Fig. 28 Fig. 29 Fig. 30

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HEARING AIDS

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26 Claims. (Cl. 179—107)

This invention relates to hearing aids of the type incorporated in spectacles, or otherwise engaged about the wearer's ear like the temple or bow of a pair of spectacles.

The invention is particularly concerned with the manner in which electrical and sound canal portions of the apparatus are mounted on the member which engages the outer ear and the manner in which the sound is communicated to the inner ear without feed back and, desirably, with directional response. The disclosure includes details of means for the pivotal movement of the ear engaging part and it includes special hinges and other forms of contacts for accommodating electrical connections in the course of such movement. Several of the embodiments disclosed are incapable of application to the wearer's ear, except through the provision of relative hinged movement immediately adjacent the outer ear. In some instances, the sound is carried through an opening made by auricolostomy in the outer ear, in accordance with my co-pending application Serial Number 308,444, filed September 8, 1952, of which this application is a continuation-in-part. In other instances, sound is communicated to the plug or insert in the inner ear without passing through the outer ear. Provision is made in some embodiments for binaural hearing.

The invention also contemplates imbedding the amplifier or battery or other hearing aid elements in plastic used to constitute portions of the spectacle frame or temple, and I have found a plastic peculiarly suited to this purpose. Its chemical composition is as yet unknown, but its manufacture is extremely simple. The product is a partial combustion product of styrene resin (the term "styrene" is used to include polystyrene). In practice styrene foam is ignited and as soon as it develops sufficient heat to melt itself, the flame is extinguished. The resulting product has characteristics very different from that of the original styrene in that it is readily soluble, melts at a low melting point, does not adhere strongly to metal and hence may be softened locally with a soldering iron or the like for the insertion or removal of the hearing aid components.

In the drawings:

FIG. 1 is a view in perspective of a pair of spectacles incorporating hearing aid apparatus in accordance with the present invention.

FIG. 2 is a view taken in section on the line 2—2 of FIG. 3.

FIG. 2A is a fragmentary detailed view similar to FIG. 2, showing an embodiment in which the components are imbedded in a plastic resin.

FIG. 3 is an enlarged detailed view showing in side elevation the inside of the right hand temple from the point of view of line 3—3 in FIG. 1, the cover plate for an internal cavity in the temple being removed to expose the electrical apparatus housed therein.

FIG. 4 is a fragmentary detailed view partially in side elevation and partially in section showing the device of FIGS. 1 to 3 as it appears in use, a portion of the wearer's outer ear being broken away to expose the connection made therethrough by the auricolostomy therein.

FIG. 5 is a detailed view taken in section on the line 5—5 of FIG. 3.

FIG. 6 is a bottom plan view taken from the viewpoint of the line 6—6 of FIG. 3.

FIG. 7 is a view similar to FIG. 1 showing a modified embodiment of the invention using a hearing aid assembly which is conventional except for the receiver, the latter being mounted in a hinged portion of the spectacle temple.

FIG. 8 is a fragmentary plan view of the hinged connection of the temple with the spectacle frame, portions being broken away to expose an electrical contact therein.

FIG. 9 is a view taken in section on the line 9—9 of FIG. 8.

FIG. 10 is an inner side elevation of portions of the temple from the viewpoint indicated by line 10—10 in FIG. 7, portions of the temple being omitted to expose the interior construction.

FIG. 11 is a view showing an interchangeable saddle for the bridge of the wearer's nose, whereby the spectacle frame may be standardized, requiring only an interchangeable saddle insert to adapt it for use by different wearers.

FIG. 12 is a view taken in section on the line 12—12 of FIG. 11.

FIG. 13 is a view in perspective of the saddle insert.

FIG. 14 is a further view similar to FIG. 1 showing a further modified embodiment of the invention.

FIG. 15 is a detailed view taken in section on the line 15—15 of FIG. 14.

FIG. 16 is a fragmentary detail view showing a further modification of the portion of the temple which engages the wearer's outer ear.

FIG. 17 is a view taken in section on line 17—17 of FIG. 16.

FIG. 18 is a perspective view similar to FIG. 14 showing a further modified embodiment of the invention.

FIG. 19 is a detail view taken in section on the line 19—19 of FIG. 18.

FIG. 20 is a side elevational view of the temple portion of the spectacle of FIG. 18, portions being broken away to expose the sound canal formed therein.

FIG. 21 is a view in side elevation fragmentarily illustrating a different embodiment of temple.

FIG. 22 is a view in side elevation of a hearing aid which rides upon the wearer's outer ear in something the same manner in which a spectacle temple is engaged therewith, portions being broken away.

FIG. 23 is an enlarged detail view of the device of FIG. 22 in side elevation with its cover removed.

FIG. 24 is a view taken in section on the line 24—24 of FIG. 23.

FIG. 25 is a view similar to FIG. 22 showing a further modified embodiment.

FIG. 26 is a view on an enlarged scale showing the device of FIG. 25 in side elevation with portions of its front wall removed.

FIG. 27 is a view of the device of FIG. 26 in rear elevation.

FIG. 28 is a view similar to FIG. 22, showing a further modified embodiment.

FIG. 29 is a view of the device of FIG. 28 as it appears in rear elevation.

FIG. 30 is a view similar to FIG. 28 showing a still further modified embodiment.

In the embodiment shown in FIGS. 1 to 6, the spectacle frame 1 has temples or bows 2 and 3 connected thereto by hinges which are desirably in multiple, as shown at 4, 5, 6 and 7 in FIG. 3. Each hinge provides a current carrying connection for leads from the cable 8 which supplies amplifier parts housed within the cavity 9 of temple 2 in the manner best illustrated in FIG. 3. These parts may include such elements as a variable resistor 10, tran-

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sistors 11, fixed resistants 12, and capacitors 13. An enlargement molded into the temple 2 at 14 receives a microphone 15 to receive the sound for amplification by the amplifier. The temple 3 has a similar enlargement at 16 for a battery 17. The amplifier sound is delivered to speakers or receivers 19, 20, mounted in the hinged extension 21, 22 of the respective temples and communicating with the user's inner ear in any one of a number of ways hereinafter to be described.

Electrical connections to the reproducers 19 and 20 is made across the hinges 23, 24 by pairs of spring contacts 25, 26, shown in FIGS. 1, 3, and 6. Connection of the battery 17 to the amplifier and connection of the amplifier to the receiver or reproducer 20 are made by means of the four wires shown at 28 in FIGS. 1, 2, and 3, these being disposed in a channel 29 in the top of the spectacle frame 1 which is desirably closed by a plastic seal at 30.

The resulting product is symmetrical in appearance, corresponding enlargements in the two temples respectively housing the microphone and the battery, and corresponding enlargements in the temple extensions 21, 22 housing the respective receivers.

Because it is desired that the extensions 21, 22 curve completely around the outer ear, it would be difficult or impossible to manipulate them into position but for the hinges 23, 24. The extent to which parts 21 and 22 project is determined by the necessity of providing connections at 32 which must be manipulated through the opening 33 in the wearer's outer ear 34 (FIG. 4) to engage in the molded insert 35 which is received into the patient's ear canal. The opening 33 is formed in the outer ear by the operation known as auricolestomy, and described in the co-pending application above identified. A passage shown at 36 in dotted lines in FIGS. 1 and 3 and in full lines in FIG. 5 leads from the receiver 19 to the tubular plug 32. As also disclosed in my co-pending application, the plug fitting 35 which fits the patient's ear canal may have a central opening at 38 through which sound may directly enter the ear canal, to be augmented by sound derived through the plug 32 and the duct 37 which leads to the inner ear beside passage 38.

In using the device shown in FIGS. 1 to 6 inclusive, the operator will first place in his ear canal the plugs 35 with their socketed ends in registry with the openings 33 in the outer ears. He will then mount the spectacle frame across the bridge of his nose in the usual way and lower the temples into place across the tops of the outer ears, maintaining the extensions 21 and 22 hinged upwardly until the temples proper are in position. Thereupon, the extensions 21 and 22 will be pivoted downwardly until the respective plug portions 32 penetrate the openings 33 of the respective outer ears and enter the socketed portion of the ear canal plugs 35. The device is then in operation, since the opening of the temples upon hinges 4, 5, 6, and 7 completes the necessary electrical circuits between the temples and the lowering of the extensions 21, 22 completes the electrical circuits to receivers 19 and 20. Although both ears receive sound in the instant device, it will be understood that only one microphone is used and one of the receivers may be omitted if unnecessary.

The device shown in FIGS. 7 to 10 is quite similar in many respects to the device shown in FIGS. 1 to 6. However, the temples 200 and 300 do not house the amplifier or the battery or the microphone, all of these conventional parts being housed in a conventional case 40 which has the microphone 150 exposed in the usual way. The voice current output from the amplifier passes through cable 42 to a plug 43 for which the free end of temple extension 210 is provided with prongs at 44 (FIG. 10). The voice currents are carried thence through wires 45 to terminals 46 engaged by the spring prongs 25, 26 disclosed in the previous embodiment. Thence the wires 47 lead back to the receiver 19 while wires 48 lead through the temple 200 and across the frame 150 and through the temple 300 to receiver 201, which serves the wearer's left ear. Aside from the fact that the conventional hearing aid case 40 is carried in the wearer's pocket or elsewhere on his person, the functioning of this device is essentially similar to that above described.

However, since there are only two wires to be accommodated, I may, as an alternative arrangement, use spring contacts at 49 to which the wires 48 are connected. The temples 200 and 300 move on a conventional hinge at 400 and when the temples are opened the engagement of spring contacts 49 with fixed contacts 50, as shown in FIGS. 8 and 9, completes the circuits across the hinged connection between the parts.

In view of the relative complexity of devices of this character, it becomes undesirable that the spectacle frame be made specially to fit the requirements of a particular user. Accordingly, with any of the spectacle embodiments herein disclosed, it is proposed that the frame be standardized, perhaps in two or three different sizes, so that any user of a frame of given size can be fitted by simply equipping the frame with appropriate lenses 52 and with a special interchangeable nose piece 55 having an external channeled contour at 56 to embrace the frame, and having a downwardly opening notch at 57 which may be custom made either by molding, grinding, or cutting to fit the contours of the bridge of the nose of the particular user. The provision of interchangeable nose pieces is a feature usable to advantage in the fitting of any type of spectacles whether or not these incorporate hearing aid mechanisms.

In the device of FIGS. 14 and 15, two entirely separate hearing aid devices are incorporated in the temples 202 and 302. It will be observed that these are rigidly connected with the spectacle frame 203 instead of being hinged thereto. Each is provided with a battery 17. Each contains its own amplifier generically identified by reference character 58 and covered by the removable closure plate 59. In this instance, the respective microphones 152 are located in webs 60 which bridge the angle between the temples and the spectacle frame, the microphones being exposed upwardly. The respective receivers 192 and 193 are located directly at the ends of temples 202 and 302. They communicate with the ear canal inserts (not shown in this view) by means of internal ducts 61 within the temples and external tubes 62 which are designed to pass in front of the wearer's external ears to the molded ear canal inserts of conventional form. Since the temples are not here required to hook around the external ear, they are relatively straight like those of conventional glasses and no hinged extensions are required. Since each receiver derives its amplified sound from a separate microphone on the corresponding side of the wearer's head, the effect produced in the auditory nerves of the wearer is binaural.

FIG. 16 shows a modification of the device of FIGS. 14 and 15 in which the extension 214 of the temple 204 is hinged at 23 exactly as in FIG. 1, and the receiver 194 is located similarly to receiver 19 in the construction of FIGS. 1 to 6. Here, however, the conduit 63, which conveys the sound from the receiver toward the ear canal, is located within extension 214 and terminates in a socket into which plug 64, at the end of a continuing conduit 65 in the temple member 204, engages when the temple extension 214 is in the operative positions shown in FIG. 16. The socket and plug arrangement permits free hinged movement of the extension but provides a continuous passage for sound when the device is in use.

Obviously the passage 65 might lead to an external tube such as that shown at 62 in FIG. 14. Instead, I have illustrated an alternative embodiment in which the passage 65 extends through a downwardly branching arm 66 which is provided at its lower end with a concave reflecting surface 67 directly opposite the ear canal, this

device being designed to be worn without a molded insert in the canal.

The device of FIGS. 18 to 20 show another variation of the construction illustrated in FIG. 14. Here one of the corner webs 60 is used to house the microphone 152, exactly as in FIG. 14, but the right hand corner web 69 houses the receiver 195. As best illustrated in FIG. 19, the battery 17 may be located immediately beneath the microphone.

From the receiver 195, a sound tube or passage 69 leads rearwardly through the short length of temple 205. At the hinge 70, the short forward fixed temple portion 205 is provided with a tubular stud 71 which, in the aligned position of temple portion 206, engages the socketed end of temple portion 206 in registry with the duct 73 therethrough. The arrangement is similar to that disclosed in connection with FIG. 16, and the FIG. 16 arrangement is duplicated at the hinge 23 which unites the temple extension 216 with temple portion 206. However, as a variant, and to show the versatility of the organization, the sound is carried through the duct 616 of extension 216 to a terminal plug 32, used as in the devices of FIGS. 1 to 5 to communicate with an ear canal insert such as that shown at 35 in FIG. 4.

In any temple such as that shown at 207 in FIG. 21, and which may have a receiver 197 at some point behind the wearer's outer ear, the sound passage 74 from the receiver may communicate with a passage 75 in a branching arm 76 terminating in such a plug 32 as that already described. The arms 76 may be used where it is desired to convert any structure of the general type of that shown in FIG. 14 for use with a connection through the outer ear when the patient has an auricolostomy.

The devices of FIGS. 22 to 30 apply some of the foregoing principles to a situation in which the user does not have spectacles in which the hearing aid or parts thereof may be incorporated. Moreover, the devices illustrated in FIGS. 22 to 30 are well adapted for installations where binaural hearing is a factor.

The fitting at 218 has considerable resemblance in its general form to the temple extension 21 of FIG. 1 or 216 of FIG. 18. Because it lies against the wearer's skull, the fitting 218 can be characterized as a skull temple fitting. It is made to curve around the wearer's outer ear 34. However, no spectacles being involved, the fitting has a downward curve at 78 which hooks it about the front portion of the outer ear. Because this particular device requires that the fitting 218 house the entire hearing aid apparatus, the fitting has increased depth as compared with the temple extensions 21 or 216. It is also made hollow and provided with a removable closure plate 79 having an aperture at 80 registering with the microphone 158. The various components of the amplifier are fitted into the cavity, as shown in FIG. 23, as is the battery 178. The volume control 81 has a knob projecting for convenience of manipulation, and the receiver 198 is, in this instance, located outside of the fitting 218 in rectilinear communication with the plug 32 which projects through the aperture 33 in the outer ear to engage the plug fitting 35 which is molded to fit the patient's ear canal. As will be observed, the device is not only compact, but is adapted, if made in right and left hand forms, to provide binaural hearing, each such device serving the ear upon which it is mounted.

It is a desirable feature of so compact a device that the receiver and the microphone be in planes at right angles to each other to minimize the possibility of feed back.

The device shown in FIGS. 25 to 27 is in many respects a reversal of that illustrated in FIGS. 22 to 24. The skull temple fitting 219 carries the microphone 159 at its rear and the receiver 199 at its forward portion. Like the previous device, it is made hollow to receive the battery 179 and the various amplifier components. This organization is a preferred arrangement for use when

the patient has no auricolostomy, the sound conduit from the receiver 199 communicating through the tube 83 with the ear canal insert 359. This latter happens to have its pressure relief and direct sound admission ports 84 disposed in annular series around the tube 83 instead of being at the center as was the opening 38 in FIGS. 4 and 22.

The device of FIGS. 28 and 29 has an exceptionally secure mounting upon the wearer's outer ear because the skull temple fitting 85 which houses the battery 86 and receiver 87 has a hinged extension 88 which extends in front of the wearer's outer ear and across the ear canal to provide a socketed portion 89 which engages the plug 32 projecting from the lower end of fitting 85 through the aperture formed in the patient's ear by auricolostomy. In this device, the extension 88 is itself provided integrally with a molded insert at 90 received into the patient's ear canal and directly over which extension 88 carries the microphone 91 so that sound reception is highly directional, the microphone being directly in line with the ear canal. The wiring from the microphone to the amplifier housed within fitting 85 is completed across the joint at hinge 23 by means of spring contacts 26 identical to those used in the constructions previously described.

The device of FIG. 30 is closely converse to that of FIGS. 28 and 29, but in this instance the microphone 93 is mounted in the skull temple fitting 94 which houses the amplifier behind the patient's outer ear. The hinged extension arm 95 terminates opposite the ear canal and carries the receiver 96 in direct alignment with and communication with the insert 99 which enters the patient's inner ear. In the devices of FIGS. 28 to 30, there is sufficient encirclement of the patient's outer ear so that, in each case, the hinged connection provided at 23 is desirable as a means of applying and removing the hearing aid. It should be noted that the contact springs 26 not only provide electrical connection across the hinged joint but also provide a mechanical detent which holds the parts against relative hinged movement, the spring contacts being provided with transversely ribbed ends shown on the largest scale at 97 in FIGS. 18 and 20 and cooperating with transversely channeled portions which may be formed in the complementary contacts, as at 98 in FIG. 16 or in the plastic or other material as shown at 99 in FIGS. 18 and 20. In FIGS. 18 and 20, these springs are detents only, having no electrical functions. If desired, the hearing aid components may be imbedded in whole or in part in plastic, as is shown fragmentarily at 209 in FIG. 2A.

A plastic peculiarly suited for the purpose is a partial combustion product of styrene. If unburned styrene is melted, it tends to adhere strongly to the mold and to the items imbedded in it. If the styrene, particularly in the form of foam, is ignited, partially burned, and then extinguished, it acquires definitely different properties from those of the styrene resin. It is dark, practically black in color, presumably from the carbon. It is extraordinarily light in weight, despite the fact that it no longer has the form of foam. Its compressive strength is high and it is tough and hard, but softens at very low temperatures. Moreover, it can be softened locally for the insertion or removal of an electric component and it releases the metal readily and completely so that the electric component is neither damaged by heat nor disfigured by adhesion of plastic. However, it adheres strongly to wood and to other resins such as methacrylate.

It has very high dielectric strength so that the wires connecting the hearing aid components can be laid into the resin without other insulation.

Moreover, this plastic is capable of very high luster when polished or when molded against metal or some other smooth surface to which it does not adhere.

Not only can it readily be softened by relatively low temperatures, but it is readily soluble in ether or acetone

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and retains its solubility. It is also readily drilled, filed and otherwise worked or polished. Paint and lacquer clings well to it.

In all of the embodiments shown, advantage is taken of the reduced physical dimensions of hearing aid components to mount these in unusually compact organizations which, in most instances, are entirely worn upon the user's head. The construction of FIG. 7 is the only one which contemplates any connection to a set carried elsewhere on the body. In most of the embodiments shown, at least a part of the positioning of the apparatus is dependent upon complete or partial encirclement of the external ear, and in many instances all visible portions of the apparatus are eliminated from the forward part of the external ear so that there is little or nothing apparent in the use of the apparatus to indicate that the user is deficient in hearing. Superior sense of direction and reception of sound are among the additional advantages, even without the binaural arrangements disclosed in some of the drawings.

I claim:

1. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, of a hearing aid comprising a microphone, an amplifier, a receiver and electrical connecting means, said receiver being mounted on said arcuate supporting means and said latter means having a sound communicating duct leading from said receiver toward the ear canal of a person wearing said supporting means about his outer ear.

2. The device of claim 1 in which said appliance comprises a spectacle frame temple provided with said arcuate supporting means.

3. The device of claim 1 in which said appliance comprises a spectacle frame temple provided with said arcuate supporting means and constituting means for housing the other said elements of said reproducer.

4. The device of claim 1 in further combination with an ear canal insert having an opening into the ear canal in which it is worn, and means providing communication between the sound communicating duct of said arcuate supporting means and the said opening in the ear canal insert.

5. The device of claim 4 in which the said means providing communication includes detachable plug and socket members respectively connected with the arcuate supporting means and with the ear canal insert.

6. The device of claim 5 in which the duct lies behind the outer ear of its wearer and the plug member extends through the outer ear, the socket member being in telescopic engagement with the plug member and in substantial engagement with the outer ear.

7. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, of a hearing aid comprising a microphone, an amplifier, a receiver, and electrical connecting means, the receiver being mounted on said arcuate supporting means and said latter means having a duct leading therefrom toward the ear canal of a person wearing said appliance, an ear canal insert having a passage with which the duct aforesaid communicates, plug and socket members in telescopic engagement and respectively communicating with said arcuate supporting means and with said insert, an eyeglass temple, and a hinge connecting said temple with said arcuate supporting means for accommodating relative hinged movement of the supporting means to facilitate application to and removal from the outer ear.

8. The device of claim 7 in which other elements of the hearing aid are housed within said temple and the temple and supporting means are provided with resiliently yieldable means connected therebetween for holding said supporting means in ear encircling position.

9. The device of claim 8 in which the said temple contains elements of said hearing aid, said resiliently yieldable means providing an electrical connection across the hinge between said last mentioned elements and said receiver, and means for opening said electrical connection in one hinged position of said supporting means.

10. The device of claim 7 in combination with an eyeglass frame with which the temple is in rigid connection and disposed substantially at right angles thereto, a web spanning the angle between the temple and the eyeglass frame, one component element of said hearing aid being mounted in said web.

11. The device of claim 7 in which said temple has a cavity in which an element of the hearing aid is disposed, and a removable closure plate covering said cavity.

12. The device of claim 7 in which said temple is provided with an enlarged mounting for the microphone element of said hearing aid.

13. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, of a hearing aid sound reproducer including a microphone, an amplifier, a receiver, and electrical connecting means, and having its receiver mounted on said supporting means, said supporting means having a sound communicating duct so positioned as to lead toward the auditory canal of a person wearing said supporting means upon his outer ear, said duct leading forwardly above the level of the lower end of the outer ear, and an ear canal insert having a flexible sound tube and having an opening extending through the insert, said tube and said supporting means having sound conduit coupling means for detachably connecting said flexible tube in sound-receiving engagement with said duct.

14. The combination set forth in claim 13 in which said coupling means comprises plug and socket members respectively connected with the supporting means and with the tube and in telescopic engagement with each other, the member connected with said tube being [illegible] forwardly of the wearer's outer ear and the member connected with the supporting means extending therefrom through the wearer's outer ear.

15. The device of claim 13 in further combination with a spectacle frame having a temple of which said supporting means constitutes a rearward extension, the receiver being mounted on the supporting means at the rear of the wearer's outer ear and the microphone being mounted on said temple forwardly of the wearer's outer ear.

16. The combination set forth in claim 15 in which the microphone and receiver are disposed substantially at right angles to each other.

17. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, an electrical sound reproducer including as elements a microphone, an amplifier, and a receiver and having one of its component elements disposed in part within said supporting means, said supporting means including a sound communicating duct so positioned as to lead toward the auditory canal of a person wearing said supporting means about his outer ear, in further combination with a spectacle frame having a temple with one of which said supporting means is connected, said spectacle frame having hollow portions housing component elements of said reproducer, and a nose bridge piece detachably connected with said spectacle frame.

18. The device of claim 17 in which said spectacle frame has widely spaced lens sockets, said nose bridge piece being externally channeled complementarily to the frame at the lens sockets and having a downwardly opening notch to fit the nose bridge of the wearer.

19. The device of claim 17 in which the nose bridge

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piece comprises a pre-fabricated insert having a downwardly opening notch and channeled side and ends, said spectacle frame having portions complementary to and receivable in said channel.

20. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, of a hearing aid comprising a sound reproducer including as elements a microphone, an amplifier, and a receiver and having at least one of its component elements disposed at least in part within said appliance, said supporting means including a sound communicating duct so positioned as to lead toward the auditory canal of a person wearing said supporting means about his outer ear, in further combination with a spectacle frame provided with temples, said supporting means constituting a part of one of said temples, said last mentioned temple having a plurality of hinges provided with axially aligned pintles, the several hinges being spaced axially of their aligned pintles and comprising electrical connections in the circuit of said reproducer.

21. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with arcuate supporting means for partially encircling the outer ear, of a hearing aid comprising a sound reproducer including as elements a microphone, an amplifier, and a receiver and having one of its component elements disposed within said supporting means, said supporting means including a sound communicating duct so positioned as to lead toward the auditory canal of a person wearing said supporting means about his outer ear, in further combination with a part in hinged connection with said supporting means and having a duct communicating across the hinge with the duct of said supporting means, said supporting means and part being provided with complementary tubular plug and socket portions engaged in one position of hinged adjustment of said part respecting said supporting means.

22. The device of claim 21 in further combination with a spectacle having a temple which includes said supporting means.

23. The device of claim 22 in which the spectacle comprises an eye glass frame with which the temple aforesaid is in rigid connection, said frame having a web spanning the angle between the frame and said temple, and a receiver mounted in said web and from which said duct leads through said temple to said supporting means.

24. In a hearing aid appliance adapted to be worn by the user to receive support from his outer ear and to deliver sound to his ear canal, the combination with supporting means adapted to rest on the outer ear and having a cavity therein, an electrical sound reproducer in the cavity and including as elements, a microphone, an amplifier and a receiver, a sound communicating duct connected with the receiver and disposed in a position to lie behind the outer ear upon which said supporting means rests, another duct so positioned as to lead from said first duct directly forwardly in a substantially horizontal direction toward the auditory canal of a person wearing said appliance, and means for connecting said ducts and including detachably connected parts substantially at the level of such an auditory canal.

25. The device of claim 24 in which the detachably connected parts comprise plug and socket elements in telescopic connection, the said elements communicating with respective duct parts substantially at the same level as the canal and at opposite sides of the wearer's outer ear.

26. A hearing aid device comprising an appliance having a portion of arcuate form adapted for at least partial encirclement of the outer ear, an electrical sound reproducer including as elements a microphone, an amplifier, and a receiver and having at least one of its component elements disposed at least in part within said appliance portion, the said appliance portion having a rear tip adapted to lie behind the outer ear and having a forwardly directed sound tube connection communicating with said receiver for the delivery of sound waves developed therein.

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HEARING AID

Filed July 3, 1961

FIG. 1

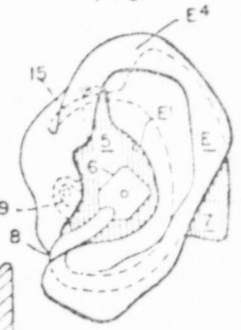


FIG. 2

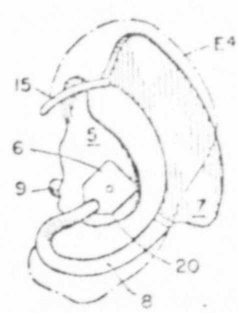


FIG. 3

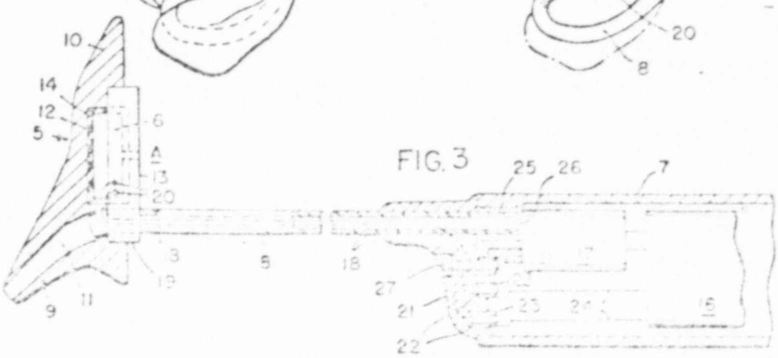
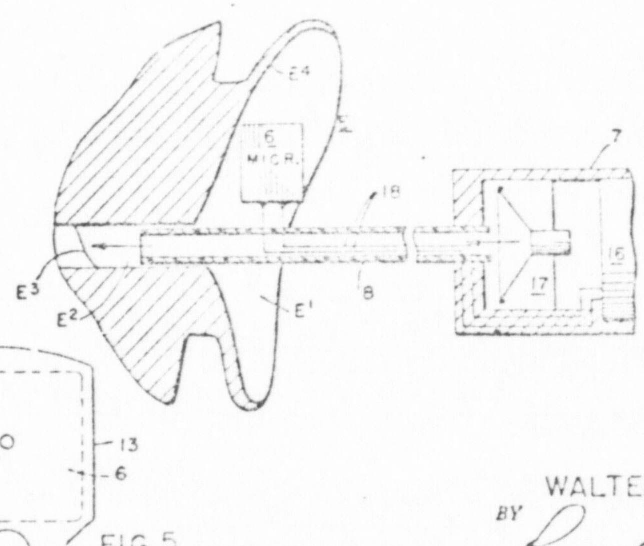


FIG. 4



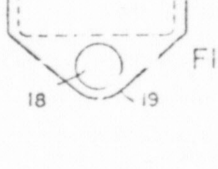


FIG. 5

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ATT'YS

Ex. 95 357

United States Patent Office

3,098,127

Patented July 16, 1963

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3,098,127

HEARING AID

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Filed July 3, 1961, Ser. No. 121,747
5 Claims. (Cl. 179—107)

This invention relates to hearing aids and particularly to improvements in such devices adapted to be worn on the ear in such a manner as to be substantially concealed.

Miniaturization of hearing aids to the point where all of the components, including the source of power, can be substantially hidden behind the human ear, and in some cases entirely within the ear, has now been accomplished. This, however, has been done by sacrifice of fidelity and sensitivity and in many cases, particularly when satisfactory amplification for ordinary sound reception is required, there is the added disadvantage of feed back to the microphone which causes distortion and other annoying sounds to be delivered by the speaker. Thus, it is the purpose of this invention to overcome these difficulties and yet retain the advantages of small size and adaptability for concealment.

The main objects of this invention are to provide an improved form of hearing aid; to provide an improved structuring of a miniaturized hearing aid which eliminates mechanical, electrical, acoustical and magnetic feed back; to provide an improved hearing aid of this kind which receives and directs sound in substantially the natural manner in which they are received and directed in normal hearing; to provide an improved hearing aid of this kind in which the speaker and power unit may be combined with the temple bar of a pair of eye-glasses or suspended on and behind the ear; to provide such a device that can be substantially concealed on the wearer's ear; and to provide an improved form of hearing aid of this kind which is of such simple construction as to make its manufacture exceedingly economical and its use very facile and highly gratifying.

A specific embodiment of this invention is shown in the accompanying drawings in which:

FIGURE 1 is an outline of a side view of a normal-shaped human ear showing suspended in position thereon an improved form of hearing aid constructed in accordance with this invention;

FIG. 2 is a view similar to FIG. 1 but showing in full outline this improved form of hearing aid and in broken outline the supporting ear;

FIG. 3 is a vertical sectional view of the microphone mounting ear plug and a somewhat enlarged and diagrammatic sectional view of the housing for the battery, speaker and amplifier, and the connection with the microphone and sound-conveying tube; and

FIG. 4 is a much-enlarged, diagrammatic sectional view of a human ear, indicating the tympanic membrane (ear drum) in association with an enlarged, diagrammatic sectional view of the connection of the microphone to the amplifier showing how the amplified sound waves generated by the speaker, are directed against the tympanic membrane quite as in the case of normal hearing, and

FIG. 5 is a plan view of the microphone cover showing the opening therethrough for the sound tube.

The essential concept of this invention involves positioning the microphone in a molded ear-plug set into the ear opening, connecting the microphone with a remotely disposed speaker, and transmitting sound from the speaker to the ear by means of a sound tube connecting the speaker with the auditory canal of the ear directly behind the microphone.

In the form shown in the drawings, a hearing aid embodying the foregoing concept comprises a molded channeled ear-plug 5, a microphone 6 mounted thereon, an instrument housing 7 and an interconnecting sound tube 8 leading through the ear plug to the auditory canal of the ear.

The ear-plug 5 may be of any form that may be found expedient for positioning in the ear E to afford connection therewith of the sound tube 8 leading from the instrument housing 7. Such an ear-plug 5 could be preformed of a molded substance and of a shape that would permit proper positioning within the average ear concha E^1 to retain the plug in place. Preferably, however, for this form of hearing aid the ear-plug 5 would be molded from a plastic substance, made from a pattern of the ear concha E^1 of the particular patient in a manner currently well known in the fitting of hearing aids to individual needs, or made directly from a plastic substance formed to shape in the patient's ear and then cured or hardened. Such an ear-plug 5 would have an external contour and cross-sectional form approximating that shown in the drawings and would be made to fit the form of the concha so as to be wholly received therein. As FIG. 3 most clearly shows, such an ear-plug 5 would have an integral stem 9 extending inwardly downward from a vertical body-part 10 and this stem 9, formed with a sound passage or channel 11, extends into the auditory canal E^2 of the ear to insure a retention of the body-part 10 in the concha E^1 of the ear E. The channel 11 conveys the amplified sound waves from the speaker to the tympanic membrane E^3 or ear drum as it is commonly called.

The body part 10, as shown in FIG. 3, is formed with an externally-facing cavity 12 for seating the microphone 6. This cavity is enclosed by a cover 13 for retaining the microphone 6, and, as indicated in FIG. 3, the microphone 6 is lined or cushioned by a suitable soft sponge rubber lining 14 applied to all the surfaces of the cavity and the inner surfaces of the cover.

The microphone 6 is a miniature unit of the type generally used with conventional hearing aids and as indicated in FIG. 3, is rather thin and flat in form and is adapted to be removably mounted in the cavity 12.

The contour and dimension of the instrument housing 7 is determined to fit behind the ear so as to be substantially concealed by the auricle or pinna E^4. In FIGS. 1 and 2 the housing 7 is shown in the form of thin, flat, arcuate-shaped element adapted to fit behind the ear with an extension or finger 15 adapted to seat over the top edge of the ear, where it joins the head, to suspend the housing 7 behind the ear. In FIG. 3 the housing 7 is shown schematically for convenience of illustration of the connection with the sound tube 8 and the leads from the microphone 6.

Such a housing 7, regardless of its contour, would be formed of light molded substance—as, for example, thermosetting plastic—in two pieces so that it could be easily assembled or disassembled for initially arranging therein or later replacing the conventional amplifier 16, a speaker 17 and a battery (not here shown). This completed unit often is referred to as a "power pack."

The sound tube 8 is formed of flexible plastic or rubber-like material such as is conventionally used for hearing aids and is of a length to permit one end to be secured to the ear-plug 5 in alignment with the channel 11 in the stem 9 and have the other end secured to the housing 7 in alignment with the speaker 17. If the housing 7 were designed to be suspended from the ear as shown in FIGS. 1 and 2, the tube 8 would ordinarily lead from the forward end of the housing 7, down under the ear lobe and up to the ear-plug 5. The tube 8 may, however, extend upwardly from the other end of the housing 7, over the top of the ear and thence downwardly to the ear-plug connection if for any reason such an arrangement

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were desired. In the latter instance the tube 8 could replace the suspension finger 15.

In the form shown, the wires 18, which lead from the microphone 6 to the amplifier 16, are associated with the sound tube 8 so that the tube 8 serves the dual function of connecting the microphone with the power unit 7 and conveying the sound waves from the speaker 17 to the ear-plug 5. Thus, as shown, the wires 18 enter the tube 8 through its side wall directly behind an extension 19 of the cover 13, which has an opening therethrough to receive and hold the sound tube 8 on the ear-plug 5 with the end of the sound tube extending into the ear-plug channel 11. Preferably the wires 18 run through the tube 8 to the power unit 7 so that they are enclosed and free from possible entanglement. The sound tube 8 is preferably secured firmly in the extension 19, and the ends of the wires 18, after emerging from the tube, are soldered or otherwise fixed to respective terminals 20 on the inside of the cover 13 where they are disposed and arranged for frictional electrical contact engagement with corresponding contact elements on the sidewall of the microphone 6.

In the form shown, the opposite end of the sound tube 8 is attached to, and extends through, a connector plug 21 adapted for detachable, plug-in, connection with the power unit 7. Preferably the connector plug 21 is molded onto the tube 8 with a portion of the tube projecting beyond the plug 21 for reception in a suitable cushion means within the power unit housing. Also the wires 18 are lead through the wall of the tube 8, within the connector plug, and are connected to respective contact pins or terminals 22, also molded into the plug 21 so as to project therefrom for reception in suitable sockets 23 in the power unit housing end wall. The sockets 23 are directly connected with the amplifier 16 by suitable leads 24.

As shown, the projecting end of the sound tube 8, which connects with the housing 7 is received in a soft rubber bushing 25 which also receives the output tube 26 of the speaker 17 and provides an enclosed passage for the transmission of sound waves from the speaker to the tube 8. The speaker is thus insulated from the tube 8 to obviate the transmission of mechanical vibrations thereto and, as will be understood, the speaker itself is mounted in a suitable cushioning material to insulate it from the housing 7.

The connector plug 21 thus serves as a detachable electrical and acoustical connecting means between the microphone-ear-plug and the amplifier-speaker power unit and, in the form shown, to obviate any inadvertent disconnect, the plug 21 is fastened to the power unit housing by means of a screw 27 which has threaded engagement with a receptacle 28 molded into the end of the housing which serves as a terminal block for the electrical connections 22—23. The connector plug could also be attached by means of a pin and a frictional socket instead of the screw 27 and receptacle 28.

It is intended that the ear-plug 5 be a custom made article onto which the microphone cover-sound tube-connector plug assembly will be attached after the ear-plug has been made to fit the patient's ear. Thus a soft mold or impression is first made directly on the patient's ear and for such purposes a dummy microphone and cover unit is provided so that the soft impression can be formed and shaped to not only precisely fit the patient's ear but also have a properly located cavity for the microphone and cover with the sound tube outlet exactly in line with the channel 11 in ear-plug stem 9. When the soft impression is completed it may be cured to permanent form or, with the dummy microphone-cover unit removed, a mold of the impression may be made and a final ear-plug cast or otherwise formed from a suitable plastic material that will retain a permanent shape.

The power units will be standard factory assembled units as will be the microphone cover-sound tube-connector plug assemblies. The latter assemblies, however,

will be made with sound tubes of several lengths to accommodate patients having different requirements.

The hearing aid construction of the present invention has material advantages over prior hearing aid devices, wherein the microphone is incorporated in the same structure as the amplifier and battery, particularly in that locating the microphone remotely from the power unit serves to obviate all mechanical, electrical, acoustical and mag[illegible] feed back problems usually present in the prior devices. Also by locating the microphone, remote from the power unit, in the concha of the wearer's ear, all sound is received in the most natural manner at the acoustical focal point of the ear as nature has formed it. Thus the wearer is less conscious of the hearing aid and has a substantially normal sense of the direction from which the sound originates.

Other advantages of this invention reside in the fact that hearing in the substantially natural manner can be had with greater fidelity of sound and with greater volume due to utilization of the behind-the-ear space for the power unit and speaker whereby extreme miniaturization of these elements as has in some cases been done, is rendered unnecessary.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that details of the construction shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

I claim:

1. A hearing aid comprising a sound channeled ear plug, an amplifier, a separate housing enclosing a receiver powered by the amplifier, means for operatively connecting the receiver and amplifier, a flexible sound tube connecting the receiver with the ear plug channel, a microphone mounted in the ear plug, and connecting wires extending within the sound tube for completing an operating circuit between said microphone and said receiver.

2. A hearing aid comprising an ear plug having a sound channel therethrough, a separate housing enclosing an amplifier and a receiver powered by the amplifier, means operatively connecting the amplifier and receiver, a sound tube connecting the housed receiver with the ear plug channel, a microphone mounted in the ear plug, and connecting wires within the sound tube for completing an operating circuit between the microphone and the amplifier.

3. A hearing aid comprising an ear plug having a sound channel therethrough and being recessed on its outer face to form a cavity, a separate housing enclosing an amplifier and a receiver and means operatively connecting the amplifier and receiver, a sound tube acoustically connecting the receiver with the ear plug channel, and a microphone seated in the ear plug cavity and having connecting wires leading therefrom into the sound tube and therealong to said housing for connection with said amplifier.

4. A hearing aid comprising an ear plug molded to fit the wearer's ear and having a centrally disposed cavity in its outer face, said ear plug having a channelled portion adapted to enter the auditory channel of the ear, a separate housing enclosing an amplifier and a receiver powered by said amplifier, means for operatively connecting said receiver and amplifier, a flexible sound tube leading from the receiver in said housing and connected directly to the channelled portion of the ear plug, a microphone seated in the ear plug cavity and cushioned from the walls thereof, and wires leading along the interior of said sound tube for completing an operating circuit between said microphone and said amplifier.

5. A hearing aid comprising a sound channelled ear plug, a separate housing enclosing an amplifier and a receiver powered by the amplifier, means for operatively connecting said receiver and amplifier, a sound tube connecting the receiver in said housing with the ear plug

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channel, a microphone mounted on the ear plug and having connecting wires leading from the microphone along the sound tube to the said housing, and a connecting element on said sound tube adapted for separable connection with said housing to provide acoustical connection of said sound tube with said receiver and electrical connection of said wires with said amplifier.

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Sept. 15, 1959 J. J. DREHER ET AL 2,904,640

COMBINATION EAR-MOUNTED MICROPHONE AND RECEIVER INSTRUMENT

Filed July 30, 195[illegible]

FIG. 3

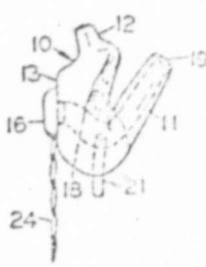


FIG. 2

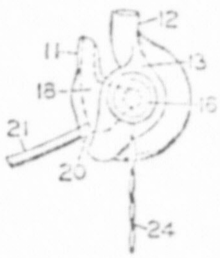
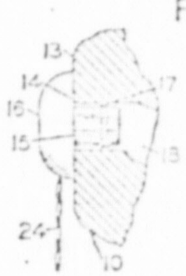


FIG. 4



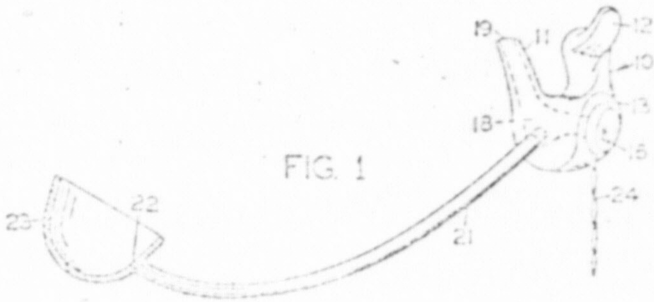


FIG. 1

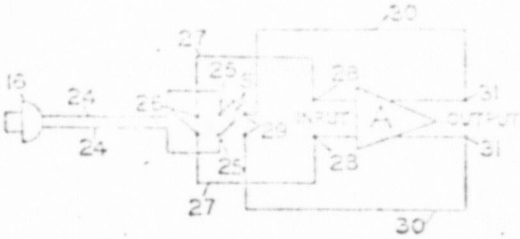


FIG. 6

FIG. 5

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Ex. 97 361

United States Patent Office — Patented Sept. 15, 1959

2,904,640

COMBINATION EAR-MOUNTED MICROPHONE AND RECEIVER INSTRUMENT

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Application July 30, 1957, Serial No. 675,078

4 Claims. (Cl. 179—156)

The present invention relates to audible signal transmitting and receiving apparatus and more particularly to a combined microphone and speaker device for use by aircraft personnel, radio operators, telephone operators or other persons using communication systems.

In the past, pilots, radio operators and other aircraft and ground personnel, have commonly used separate earphone-type receiver or speaker devices and lip, throat, or hand-held microphones to respectively receive and transmit voice signals. In some instances, the earphones and microphone are built into, or mounted in aviators' helmets or oxygen masks, or may be simply worn over the head and held in the hand where desirable. With the advent of high altitude flight, the hand-held microphone has been substantially replaced by the throat-type microphone or by a lip-type microphone built into the usual oxygen mask. However, considerable difficulty is still encountered with the so-called built-in types of earphones and microphones and the same are relatively costly and in some cases uncomfortable and unsanitary from the standpoint of the wearer.

Also, it has heretofore been proposed to employ the usual type of electromagnetic-vibrating diaphragm-type of earphone or receiver device as both a receiver and as a microphone, but due to the relatively high noise level encountered in aircraft operation, previous attempts along this line have proved unsuccessful in attaining a desired signal-to-noise ratio necessary to transmit a clear, ungarbled and intelligible signal.

Accordingly, the primary object of the present invention is to provide a structurally simple lightweight combination microphone and speaker device adapted to be mounted in and upon the human ear and operable selectively either as a microphone or speaker in transmitting voice signals to and from the ear of a wearer.

Another object of this invention is to provide a combined ear-mounted microphone-speaker which is characterized by its ability to transmit comparatively clear, ungarbled and intelligible voice signals and which attains, when operating as a microphone, a desirably high signal-to-noise ratio without resort to the use of cumbersome and uncomfortable ear pads or other noise-shielding equipment.

It is a further object of the present invention to provide a device of this character which may be constructed from comparatively inexpensive, lightweight and readily available component parts, and one which may be easily fitted to and supported by the human ear and worn and operated in greater comfort than has heretofore been possible with the use of conventional types of earphones, headsets and microphones.

For a further and more complete understanding of the present invention and the various additional objects and advantages thereof, reference is made to the following description and the accompanying drawing, wherein:

Fig. 1 is a perspective view, partially in vertical section, of a preferred form of microphone-speaker device formed in accordance with the present invention;

Fig. 2 is a side elevational view of the ear plug or body portion of the present microphone-speaker device looking toward the outer side thereof;

Fig. 3 is an end elevational view of the ear plug body;

Fig. 4 is an enlarged fragmentary vertical sectional view taken through the ear plug body and illustrating the relative location of the sound-to-electrical impulse transducer;

Fig. 5 is a small scale perspective view illustrating the present microphone-speaker device as worn in the human ear;

Fig. 6 is a diagram of the electrical circuit of the sound-to-electrical impulse transducer and associated amplifier and switching mechanism.

The present invention proceeds on the principle of using a single, standard type of sound-to-electrical impulse transducer, both in the capacity of a microphone and as a receiver or speaker device. Furthermore, the present invention contemplates the use of such a transducer in combination with a molded plug-like body adapted to be snugly fitted directly to the outer regions of the human ear and formed so as to transmit audible signals both to and from the ear canal. Recent experiments have shown that voice signals may be transmitted with efficiency through the human ear canal and/or through the bone or tissue structure of the skull and ear. However, in surroundings of relatively high ambient noise and/or vibrations, such as in aircraft operation, it has been found that ambient noises and vibrations may also be transmitted through the skull and ear, thus making it difficult to attain a desired high signal-to-noise ratio which is necessary to transmit a clear and intelligible voice signal.

We have found that it is possible to obtain a desired signal-to-noise ratio in aircraft operations by utilizing an acoustic coupling of mouth and ear-emitted signals, such combined signals being conducted to the sound-to-electrical impulse transducer through suitable merging passages where such combined signals are translated into electrical impulses, amplified, and broadcast through conventional radio apparatus.

Referring now more particularly to the drawing, wherein is illustrated a single preferred form of the present invention, the numeral 10 designates generally a plug-like body which is preferably molded or otherwise formed from a suitable synthetic resin, and shaped to snugly and directly fit into the exterior regions of the human ear. The ear plug body 10 may, if desired, be custom molded to fit the ear of the individual wearer, or may, where desirable, be formed in generally standardized sizes and shapes after the manner of the usual ear plug or mold employed in connection with the ordinary hearing aid device. In the usual manner, the ear plug body includes a laterally projecting pipe-like extension 11 adapted to extend a distance within the ear canal, and a convoluted upper and forward retaining finger 12 which is adapted to fit beneath the outer tissue flap of the human ear to hold the plug or mold body 10 in substantially snug, flush-fitting relation to the exterior portions of the ear. The body 10 further includes a flat outer side portion 13 which is formed with a cylindrical socket 14 to frictionally and removably receive the tubular stem portion 15 of the usual button-like hearing aid transducer 16. In order to frictionally retain the transducer 16 within the socket 14 of the ear plug body 10, the latter is formed with an annular radially inwardly extending rib 17 which resiliently and frictionally engages the tubular stem portion 15 of the transducer 16 to hold the latter within the socket 14 against accidental withdrawal.

Communicating with the transducer-receiving socket 14 is an internal passage 18 which extends transversely through the body 10 and terminates in an opening 19 at

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the end of the canal extension 11 of the body. The body 10 is also formed at its forward end with a relatively small diametered socket 20 communicating with the passage 18, and in which is press-fitted the inner end of a relatively small diametered hollow tube 21. The tube 21, as shown in Fig. 5, is arranged to extend forwardly and laterally inwardly of the plug body 10 so as to partially encircle one side of the face of the wearer, and terminates substantially closely adjacent the lips of the wearer in an opening 22. Advantageously, the outer open end 22 of the tube 21 may be provided with a relatively small hemispherical cup-like body 23 which opens toward the mouth of the wearer so as to effectively focus voice signals emitted from the mouth and channel the same backwardly through the tube 21. If desired, particularly when the present device is used in aircraft operations, the open end of the cup-like body 23 may be closed by a protective film of polyethylene resin or the like so as to minimize undesired wind or other ambient noises.

Thus, it will be seen that when the present microphone-speaker device is used in the capacity of a microphone, voice signals, or sounds are conducted both through the tube 21 from the lips of the wearer and also through the ear canal to the internal passage 18 of the plug-like body 10 where the ear and mouth transmitted signals or sounds are combined and impressed upon the sound-sensitive element of the transducer 16. It is also thought that at least a part of the voice signals emitted by the wearer may be conducted through the bone structure of the skull and thence possibly through the tissue of the ear to the plug-like body 10, and thence to the sound-responsive element of the transducer. It has been found through experimentation that the signal-to-noise ratio encountered in ordinary aircraft operations is such that ear-transmitted signals alone, without a coupled mouth-transmitted signal results, in some cases, in a garbled unintelligible transmission. This is believed due to the transmission of external noises and vibrations through the body of the wearer and to the plug-like body 10 and thence to the transducer. However, by combining both mouth and ear transmitted signals, the signal-to-noise ratio is increased to a degree where the resultant broadcast is entirely clear, ungarbled and intelligible.

Fig. 6 of the drawing illustrates diagrammatically the operating circuit for the present combination microphone-speaker device. The sound-to-electrical impulse transducer 16 is provided in the usual manner with a pair of lead wires 24 which extend remotely from the button-like transducer and which are electrically connected respectively with the center poles or terminals 25 of a double pole, double throw switch S. It will be understood that the switch S may take any suitable standard form and may be located in a convenient, readily accessible position to be operated by the hand, or foot. The switch may, if desired, be spring pressed to a position to electrically connect the transducer 16 to the output side of the associated amplifier A, in order that the wearer may normally listen to or receive incoming signals, and may be manually switched to an opposite position connecting the transducer 16 to the input side of the associated amplifier A, in order that signals may be broadcast or transmitted by the wearer. Toward this end, the switch S includes a first set of secondary terminals 26 which are connected by the leads 27 to the input terminals 28 of the amplifier A. The switch S further includes a second set of terminals 29 which are electrically connected by the leads 30 to the output terminals 31 of the amplifier A. It will here be understood that the circuit diagram of Fig. 6 does not include in its showing the usual radio receiver and transmitter components, other than the common amplifier A which may be selectively connected either to an associated receiver or transmitter circuit in a manner well known in the art.

Thus, in the operation of the present microphone-speaker device, the switch S may be moved selectively to a position connecting the transducer 16 with the output of the amplifier A by way of the switch terminals 29 and leads 30 in order that the wearer may listen to incoming radio signals or broadcasts. Merely by manipulating the switch S to connect the transducer 16 to the switch terminals 26, the transducer is connected to the input side of the amplifier A in order that voice signals may be broadcast through the device.

In view of the foregoing, it will be seen that the present ear-mounted combination microphone-speaker or earphone device may be constructed of more or less standard, readily available and lightweight component parts, and may be connected through the use of a suitable double pole, double throw switch mechanism with the amplifier of a standard radio receiver-transmitter apparatus so as to function selectively both as an earphone receiver or speaker device and as a microphone.

The present combined ear-mounted microphone-speaker is characterized by its economy of manufacture, its comfort to the wearer and its operational efficiency and capability of attaining a sufficiently high signal-to-noise ratio, when operated as a microphone, to transmit clear ungarbled and intelligible signals even in surroundings of relatively high ambient noise. Further, due to the relatively small size and compactness of the present microphone-speaker, the same may be used conveniently by aircraft personnel and worn within the usual aircraft crash helmets or the like without in any way interferring with or obstructing the wearer.

While we have disclosed what we look upon to be a presently preferred form and construction of our improved combination microphone-speaker, it will be understood that the same is susceptible to modification in regard to details of construction and design without departing from the spirit of the invention or the scope of the following claims.

We claim:

1. A combination ear-mounted microphone and receiver comprising an ear plug body arranged to directly and snugly fit within the outer portions of a human ear and formed with a relatively elongated extension arranged to extend within the ear canal and an internal passage extending through said extension and terminating in a socket adjacent an outer surface of said body; a sound-to-electrical impulse transducer carried in said socket and communicating with the internal passage thereof; and an elongated tubular member having one end connected with said body and communicating with the internal passage formed therein, said tubular member extending outwardly from said body and terminating in an open outer end portion disposed closely adjacent the lips of a person in whose ear said body is fitted, the passage of said body and said tube serving to conduct sound waves emitted both from the lips and ear of a wearer to said transducer.

2. A combination ear-mounted microphone and receiver as defined by claim 1, including a relatively enlarged cup-shaped device carried on the open outer end of said tubular member.

3. A combined microphone and speaker device comprising an ear plug-type body formed with an open-ended passage extending therethrough and arranged to snugly fit within and be supported by the exterior regions of the human ear; a single sound-to-electrical impulse transducer carried in said body in communication with one end of said passage; and a relatively small diametered, open-ended, hollow tube carried at one end thereof by said body and communicating with the passage of said body intermediate the ends of said passage and having an opposite end portion extending remotely outwardly from said body and arranged to terminate adjacent the lips of a person in whose ear said body is positioned, said tube serving to conduct mouth-emitted sounds from the lips of a person wearing said device to the passage of said body and thence to said transducer.

4. A combined microphone and speaker device comprising a body of a shape and size to at least partially and

snugly fit into a human ear and having a passage therein arranged to communicate directly at one end thereof with the canal of an ear into which said body is fitted; a single sound-to-electrical impulse transducer carried by said body and communicating with the opposite end of said passage; and a relatively small diametered, hollow tube carried at one end by said body and arranged to extend outwardly from said body to a position closely adjacent the lips of a person in whose ear said body is positioned, said tube being open at both ends thereof and having one end communicating with the passage of said body intermediate the ends thereof, whereby sounds emitted from the lips of such person may be conducted through said tube to the passage of said body and thence to said transducer.

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#6

Started work ~~Tuesday~~ Monday 23 December 1968 to layout concepts of a Post Auricle Type headset.

Provisional layouts completed Dec 30 1968 indicated that a full size receiver and ½ size microphone would fit in the space and shape envisioned. (Receiver 831519 300Ω. Mic BJ 1591 5000Ω)

The concept of the mic & Receiver ports emanating from the top of the ear was pursued until Jan 2 1969. The concept of the mic outlet over the ear and the receiver outlet under the ear was then evaluated and a layout completed Jan 7 1969.

A drawing (63185-1) for a solid model of a headset was drawn Jan 6 1969. The followed the concept of mic over ear and receiver under ear. This model was completed 1/7/69 but was not correct in some of the details of shape over the ear. A second solid model of this shape was completed by 1-10-69

A drawing (63185-2) for a solid model of a headset with mic & receiver outlet, both over the ear, was drawn Jan 8 1969 and a model completed by Jan 11-1969

Preliminary fitting of the first & second models to various people's head indicated that an angular adjustment of the acoustic tube would be necessary in a vertical and horizontal plane so various methods were laid out and sketches produced (63185-3) Jan 10 1969

EP 2312

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To produce a model of the ball Joint concept for the acoustic tubes:-
Minnesota Rubber. (612-929-6781) Mr Wally Dahl was contacted for Sample 'O' and quad rings 8004 & Q4004 respectively. these will be mailed Jan 14.69 The only stock material is Buna-N. 70 durometer.
Also contacted Parker Seal Co 415-357-1900 and requested sample O'Rings same size & material.

J. Hutchings 1-13-69.
Witnessed and Understood
W. H. Schomberg
1-13-69

Jan 13-1969.

The feasibility of a plug in capsule cable was commenced with discussion with Vendors on miniature plugs & sockets on Tuesday Jan 7 1969. AMP & Burndy reps were in plant and samples were obtained for preliminary investigation of suitability.
Layout work was commenced on the cable entry Jan 11 1969.

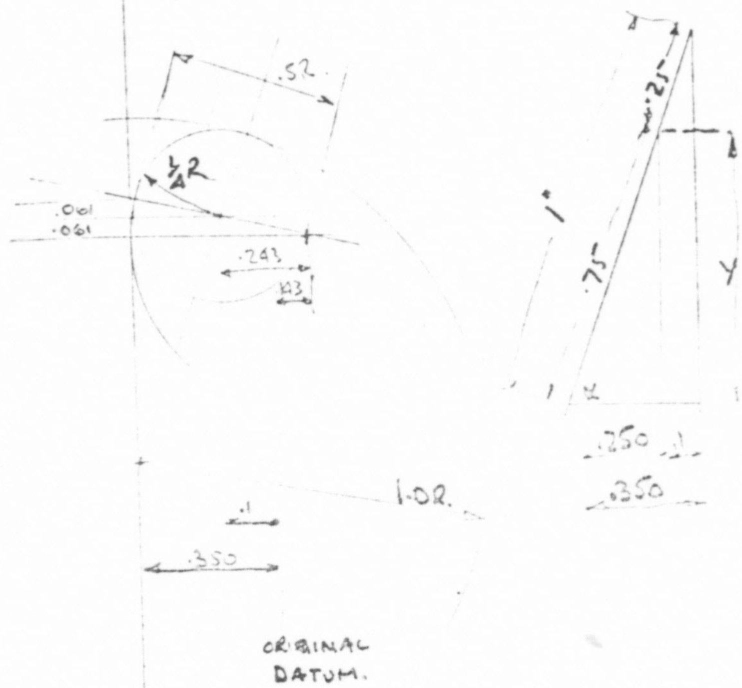
J. Hutchings 1-13-69
Witnessed and understood
R.J. Bernardi 1-20-69

EP 2311

1-14-69.

Decision made to persue the concept with mic outlet over ear and earth outlet under ear.

To layout dimensions of shape of inside form.



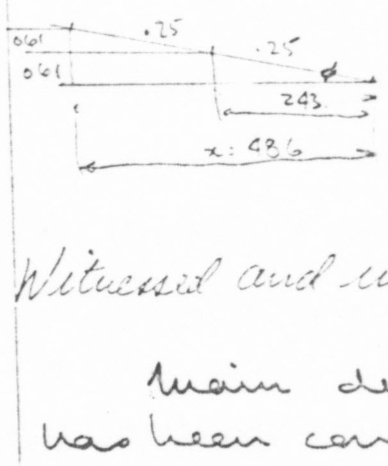
$\cos\alpha = \frac{.250}{.750} = .3333$

$= 70°\ 40'$

$\sin 70°40' = \frac{Y}{.75}$

$.9436 \times .75 = Y$

$Y = .708$



$\cos\phi = \frac{x}{.5} = .9714 = \frac{x}{.5}$

$x = .5 \times .9714 = .486$

K. Hutchings 1-14-69

Witnessed and understood, R. J. Bernardi 1-20-69

1-18-69.

Main design effort since 1-14-69 has been concentrated on providing a removable capsule cable. A method was devised which will probably be suitable for the initial models. It is not an ideal solution and it appears that PPI will have to look up for a method of our own design ~~with~~ rather than attempt to use proprietary point.

EP 2310

1-18-69

Measuring of subjects wearing solid model No 1 has been proceeding. This operation should be completed by Monday Jan. 20. From the data obtained any change that are required can be evaluated and final layout for working model can be started

K Hutchings 1-18-69

Witnessed and understood, R. J. Bernardi 1-20-69

2-4-69

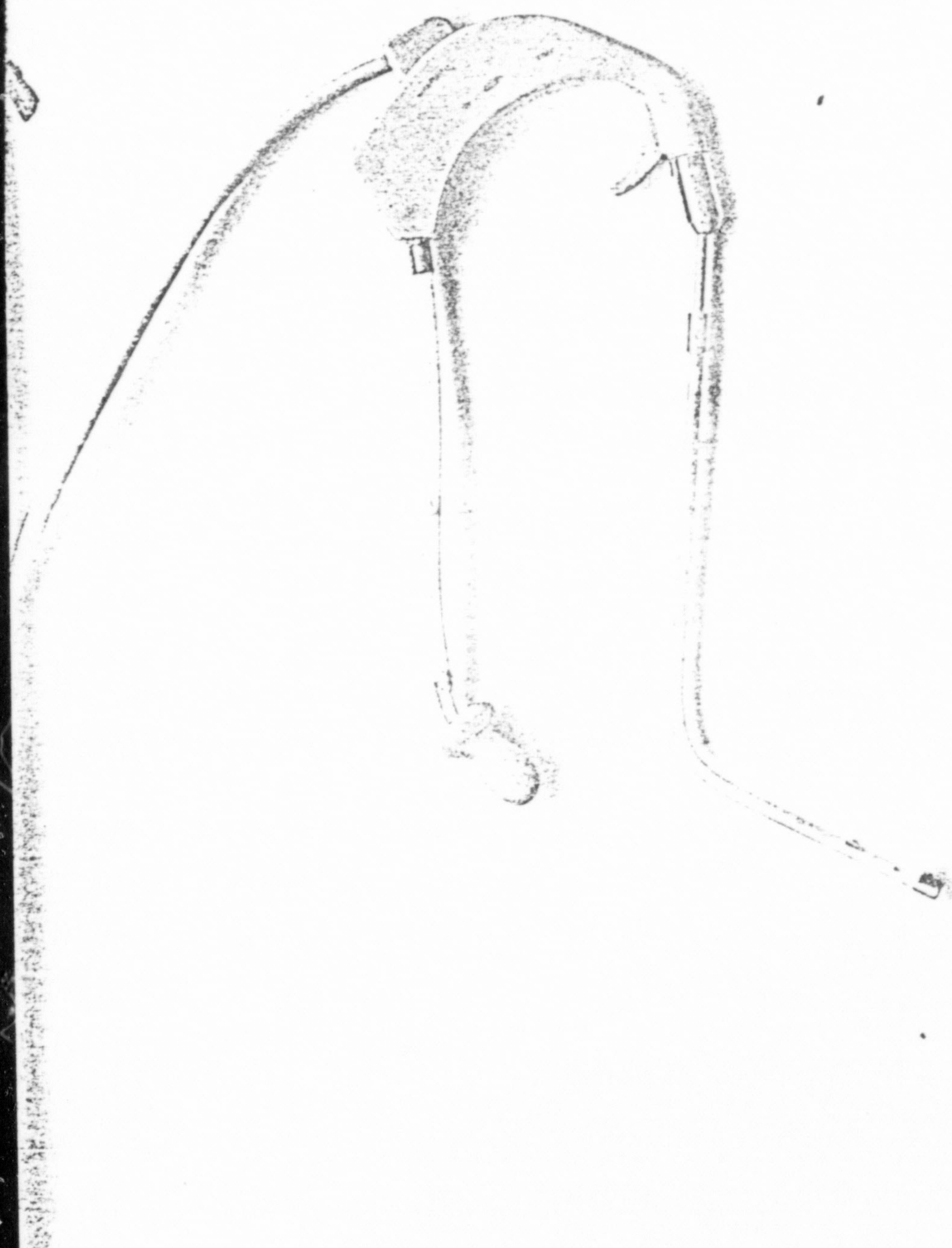
First working model of post aural headset completed 12 noon today

K Hutchings

Witnessed and understood, R. J. Bernardi 2-4-69

EP 2309

PLAINTIFF'S EXHIBIT 103



Ex. 103 37

Ex. 104 371

ROANWELL
CORPORATION

DATE Dec. 15, 1969

H. W. CLARK cc: H. C. Potter SUBJECT MOH [illegible] TS

PLAINTIFF'S EXHIBIT 105

R. T. Ennis REF.

C O N F I D E N T I A L

As a result of recent discussions with people at General Tel, United and Continental I feel it is safe to assume that the Model R70A headset will be chosen in preference to the Model R61A. This confirms our previous assumption that the earmold problem would frighten the independent companies due to its cost and logistical complexities.

Andy Buchner and John Bentley of G T & E Service Corps, Charles R. Fehr Product Manager, United Systems Supply, and Frank M. Harlan, Vice President-Traffic, Continental have all expressed a preference for the Model R70A.

I have invited all of the above gentlemen to visit our plant to witness laboratory performance tests of the Model R70A as soon as such tests can be performed by our Engineering Dept. (preferably some time in January). In this way I hope to short-cut the approval interval normally required for the standardization of new products in each of these companies. As soon as we are fully prepared to demonstrate the Model R70A in our lab, firm dates will be arranged with each company for separate demonstrations. If possible, we should also arrange to have a model R70A headset available for "loan" to each of the above companies for field trial purposes prior to the demonstrations.

I recommend that we hold a meeting immediately to determine:

1. What is a reasonable target date for the first demonstration?

2. Can literature and specifications be made available for the demonstrations?

3. Are sufficient samples on order now or can they be made available for loan purposes?

4. Shall we offer both over-the-ear and/or under-the-ear Model R70A headsets?

5. Are commercial equivalent components on order to replace Western Electric Supply components?

6. Do we have sufficient cost information to prepare prices prior to the demonstrations?

I feel it is important to emphasize once again that the sample headsets we submit to both Bell and the independent companies must appear to be production items. I recognize this poses a considerable number of problems. However, submission of model shop items which are obviously not of production quality is sufficient cause for rejection by our prospective customers. I also recognize that this requirement could very well increase the cost of the models many times over the quoted price. Regardless of this fact the stakes are such that we cannot afford to compromise this requirement.

R. T. Ennis

rte;gw

Ex. 105 872

F46
0065
JUL [illegible]

M. E. WHITNEY ASSOCIATES INC.
FORMERLY AN ARCO AFFILIATE

TECHNICAL SALES REPRESENTATIVES

4405 East-West Highway • Bethesda, Maryland 20014 • Telephone 301-654-8634

July 10, 1970

To: R. T. Ennis, Roanwell

From: Myron E. Whitney

Subject: FAA - MOH Conference

This will record the discussions during the conference June 11, 1970 at the FAA Headquarters with these people attending:

William R. Miller	- FAA Code FI230, Engineer leased equip.
Clair R. Morris	- FAA Code FI330, Engr. purchased equip.
Robert C. Stevens	- FAA Code At31, Air Traffic Service
R. T. Ennis	- Roanwell
M. E. Whitney	- Roanwell

Mr. Ennis presented the new line of Miniature Operator's Headsets, R-61A, R-70A and R-71A. The conference timing was good as the FAA has officially asked ATT to supply the new PPI Star Set in place of the currently used PPI MS-50 (Ref: Report dated 3/24/70 MEW to RTE "FAA Evaluation of PPI Star Set")

FAA has advised that ATT must run its own field tests to appraise performance and service/maintenance problems, no doubt influenced by excessive troubles with the MS-50. When ATT will finish these tests is not known.

After careful and knowledgeable examination of the 3 Roanwell models and through discussion of the various features these are the pertinent FAA observations:

1. The R-61A will probably have little or no application since the FAA made tests at Fort Worth about two years ago of Bell Lab prototypes. The vote was overwhelmingly "no" based largely on resistance to the custom moulded earpiece. Paradoxically, however, William Flener, Code At-1, the highly competent and respected Director of Air Traffic Service, has just directed that provision be made for the FAA to make available custom moulded earpieces for use with the current PPI MS-50 for those controllers that desire them. This has evolved from a number of controllers having purchased these pieces at their own expense.

   In view of this, a later reversal is not impossible when the R-61A becomes available in the ATT supply channels.

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Ex. 106 373

R. T. Ennis Page 2 July 10, 1970

2. The R-70A and R-71A both evoked interest with general endorsement of the overall physical designs of the unit, of the obvious reliability of the transducers and of the separation of th cordset into two sections in response to their earlier request, that the heavier lower portion with amplifier and P/T switch can remain at the position making the personal issue headset lighter and easier to store.

   Mr. Stevens, representing the group responsible for liaison with users, requested that Roanwell arrange with ATT at 195 Broadway for Bell system field tests of the R-70A and R-71A, coordinating directly with Richard Hazlett, Chief (393-2856) and Robert Naylor, Engineer (393-4039). FAA will dispense with its own tests and rely completely on ATT results. FAA has been working with James Weiner - ATT Long Lines, Washington, Special Assistant to Benjamin Oliver, V. P. It was agreed Roanwell would not make any contact with Weiner at this time.

3. To reduce background noise, the group felt all models should have a cup of some sort over the end of the voice tube found necessary on the PPI MS-50.

4. A moulded earpiece should be made available for the R-70A and R-71A to meet individual requests to be handled through local area moulding facilities.

5. Specification sheets were requested to be made available as soon as available.

Since the conference I have concluded that later on at the time you have made arrangements for ATT tests, we show models at FAA higher levels of management, e.g., A. E. Cole, Code AT31, Chief Command Control Systems Branch, Air Traffic Service; Robert N. Meier, RD200, Chief Communications Development Division; and possibly, Mr. Flener, referred to previously under R-61A. Meanwhile, I shall talk with both Messrs. Cole and Meier to explain the general plan - their concurrence is essential.

Myron

Myron E. Whitney

MEW:ld
cc: V. C. Gelso
H. W. Clark

E.P. 1095

375

108

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

PLANTRONICS, INC., Plaintiff, v. ROANWELL CORPORATION, Defendant.	:	Civil Action No. 72 CIV 1625 Judge Conner

STIPULATION

The parties hereto, by their respective attorneys, the honorable court approving, stipulate as follows:

1. The issue of damages shall be severed from the liability issues, and postponed for trial.

2. For purposes only of the liability issues in this case, and not in determining the amount of plaintiff's damages, the attached headset sales figures are agreed to be substantially accurate.

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& RAYMOND
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New York, New York 10020
212/489-3300

Attorneys for Plaintiff

Approved by:

Ex. 108 376

Plantronics MS-50

Fiscal year:	1962-63	–	1492	units sold
	1963-64	–	14,698	" "
	1964-65	–	19,753	" "
	1965-66	–	34,439	" "
	1966-67	–	81,183	" "
	1967-68	–	76,984	" "
	1968-69	–	105,562	" "
	1969-70	–	102,357	" "
	1970-71	–	99,431	" "
	1971-72	–	79,149	" "
	1972-73	–	50,830	" "
	1973-74	–	53,558	" "

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Plantronics StarSet

1969:	4th Quarter	-	492	units sold
1970:	1st Quarter	-	6,753	" "
	2nd "	-	3,129	" "
	3rd "	-	5,244	" "
	4th "	-	11,144	" "
1971:	1st Quarter	-	8,155	" "
	2nd "	-	17,503	" "
	3rd "	-	18,568	" "
	4th "	-	26,678	" "
1972:	1st Quarter	-	31,760	" "
	2nd "	-	43,576	" "
	3rd "	-	34,287	" "
	4th "	-	40,131	" "
1973:	1st Quarter	-	49,520	" "
	2nd "	-	34,298	" "
	3rd "	-	50,080	" "
	4th "	-	55,536	" "
1974:	1st Quarter	-	49,181	" "
	2nd "	-	60,678	" "

Model 61 (Roanwell and Western Combined)

1970:	3rd Quarter	–	984	units sold
	4th "	–	2,997	" "
1971:	1st Quarter	–	6,403	" "
	2nd "	–	14,585	" "
	3rd "	–	13,808	" "
	4th "	–	16,969	" "
1972:	1st Quarter	–	12,620	" "
	2nd "	–	11,827	" "
	3rd "	–	7,350	" "
	4th "	–	8,22[illegible]	" "
1973:	1st Quarter	–	0	" "
	2nd "	–	0	" "
	3rd "	–	726	" "
	4th "	–	0	" "
1974:	1st Quarter	–	0	" "
	2nd "	–	0	" "

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Roanwell R70

1973:	1st Quarter	-	3,052	units sold
	2nd "	-	2,332	" "
	3rd "	-	879	" "
	4th "	-	2,846	" "
1974:	1st Quarter	-	536	" "
	2nd "	-	16	" "

380

387

Roanwell R71

1973:	1st Quarter	-	1,824	units sold
	2nd "	-	1,475	" "
	3rd "	-	254	" "
	4th "	-	112	" "
1974:	1st Quarter	-	74	" "
	2nd "	-	19	" "

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EXHIBIT

3 copies please

M. E. WHITNEY ASSOCIATES INC.
FORMERLY AN ARCO AFFILIATE

TECHNICAL SALES
REPRESENTATIVES

1400 N. Uhle Street • Arlington, Virginia 22201 • Telephone 703-524-5642

March 24, 1970

PLAINTIFF'S EXHIBIT 110

To: R. T. Ennis, Roanwell

From: Myron E. Whitney

Subject: FAA Evaluation of PPI Star Set

Friday, March 20th, I met with Robert C. Stevens, FAA code AT31, the group responsible for coordination of FAA tests of the new Pacific Plantronics Star Set. I am quoting below Mr. Stevens' report as compiled from data supplied by FAA personnel at Cleveland and Minneapolis where the tests were conducted.

		Cleveland	Mpls	Totals
What type Headset was used prior to the Star Set?	MS 50	20	10	[illegible]
	GR 52	4	11	15
Was the Star Set More or Less Comfortable?	More	19	17	36
	Less	0	1	1
	NC	5	3	8
Did you find Improved Operation?	Yes	22	15	37
	No	1	4	5
	NC	1	2	3
Will Star Set Increase or Decrease fatigue?	Increase	0	1	1
	Decrease	16	15	31
	NC	8	5	13
Would you use Star Set if it Were available?	Yes	22	18	40
	No	1	3	4

It is our opinion that the evaluation shows the Star Set to be the most suitable and acceptable instrument used to date. However, prior to taking procurement action the following potential improvements should be explored with PPI:

1. The PTT switch should be wired so that both cords come from the same end of the switch casing.

F 0776

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Ex. 110 382

2. Improve eyeglass clip design.
3. Remove sharp corners from PTT switch button.
4. Make PTT switch easily convertible to non-locking.
5. Make cord between PTT switch and headset longer than on the MS 50 probably about 44" long instead of 40". Informal reports indicate that a tall man standing in a tower cab pulls the instrument from his ear when he puts his hand at his side.
6. Provide a hearing tube that can accommodate a custom molded earpiece.
7. Provide a variety of retractible cord lengths.

In further discussion these several points came up:

1. Admittedly the field tests show nothing about maintenance and all the interest was on the user reaction. Concerning maintenance, the phone company has a one-year warranty on the present MS 50 PPI unit, but are charged $30 repair for each unit returned to the factory. It is the FAA's hope that the Star Set can be serviced locally since its design is aimed at being able to replace the mike amplifier, various elements, cord assemblies, etc. It would benefit the FAA whether they buy or lease as factory repairing requires more spare units.

2. FAA has written to AT&T requesting that the new Star Set be made available and has also asked that the FAA be permitted to buy it from PPI instead of leasing. They have received no answer nor any indication of what the answer to these two questions may be.

3. Mr. Stevens would like to be able to obtain the new Star Set without the need for a specification simply requesting that this new unit be supplied. At this time in the meeting we were joined by William R. Miller, Communications Equipment Engineering Section, Code ED251, with whom I have had earlier conferences. Mr. Miller told Mr. Stevens that any FAA procurement would require an FAA specification. Mr. Miller also informed us that a new performance specification is circulating and is having trouble gaining acceptance because it does not specify reliability. This would be very important for our new unit.

With the PPI evaluation completed and with the FAA interest in improved lightweight telephone operator's headsets, I think the timing is right for us to schedule a meeting with the FAA people to show them our new prototype units and to discuss with them the first steps of an improved specification. In preparation for this meeting, I think we should have together some of our ideas of what a new specification might embody with particular emphasis on reliability.

Myron E. Whitney

F0787

MEW:ld
cc: Mr. Clark; Mr. Gelso

003188

(383)

Mr. Joseph Lagman March 15, 1962.

Mr. J. R. Johnson

Dear Joe:

We are pleased to report that we have worked out a satisfactory arrangement with Plantronics.

As you know, I am convinced that their development has excellent long range marketing potential and, therefore, if handled properly, can result in a plus to the Audiotone operation.

Attached is a copy of the agreement which Larkin and I have signed. This agreement is a long way from being a fancy legal document and possibly has some loopholes. However, we are not searching for those problems. The agreement does define a course of action that will certainly protect us for a reasonable period of time. If we can do a first class job from a design and economic standpoint we can throw the agreement away because I am convinced that good performance on our part will result in a continuing relationship with Keith and Court.

You are to begin immediately designing a "behind the ear" unit containing the necessary transducers and speaking tube plus an amplifier for this unit. In addition, cord and switching devices plus plugs will be needed in the final package. However, I am not too concerned about these matters at this time. A real effort must be made to design a good unit that will meet the F.A.A. requirements and be very low in cost. Quality cannot be sacrificed. However, every bit of ingenuity from a production, purchasing and design standpoint must be employed.

We are searching around for an aircraft radio transceiver which will give you the necessary capital equipment to proceed with the project. This we should locate in a few days. We will ask you to place a purchase order as soon as we find one. In addition, we have asked Ray Bohanan to make a thorough check of all light aircraft in regard to the arrangement of microphone and headset receivers in the airplane plus the impedance match that is common to the various types of aircraft and aircraft radios.

Ex. 111

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There are very definitely two schools of thought on the speaking tube. Barney feels that the design of the tube is quite straight forward and that the material used in the tube is not critical from an acoustical standpoint. Court Graham takes an opposite view and is of the opinion that the material and construction is most critical. Court is quite candid in his statements when he admits that he cannot explain the phenomena but insists that some strange phenomena exists in regard to material and design. Court has successfully built a number of tubes that work well. Barney is a recognized expert on acoustics. Quite frankly, I respect both Barney and Court and I am in a bit of a quandry as to who is right.

So that we can move as expeditiously as possible I suggest that Barney spend a limited amount of time, not more than a day or two, to see if he can come up with a satisfactory tube. If he is not successful then let's go directly to Court and have him make up what we will need. If this latter route is used we will never prove or disprove anything but we will get the show on the road. Let us all recognize that Court does have a working device. We are in this together and time can be saved by utilizing the knowledge that we have available. I would not recommend this course of action if the tube were a costly item where Barney's efforts might result in a real cost saving. This, however, is not the case.

After discussions with Court and Keith, I am of the opinion that the best way to design the behind-the-ear job is to bring the tube out the bottom instead of over the top. If you will study facial structures I am sure you will agree that this is about the shortest route and simplifies the problem of separating input and output. In addition, this will give a better balanced device which I feel will hang well on the wearer's ear. It will also simplify the problem of the user's glasses.

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Mr. Joseph Lagnan Page 3.

You are going to have to do a real purchasing job to assure us the lowest cost transducers since this is a big element of cost. Every effort should be made to get the best possible deal. The other tough area will be the amplifier design. Cost must really be whittled out of this area.

Court Graham has considerable information developed to date on specifications and requirements. Please contact Court and arrange to have this information forwarded to you as soon as possible.

In regard to the $3.00 deal on the MS50 program, Keith agrees that this is to cover mounting and sealing the transducer package. There will be no requirements on our part to drill and tap any holes. You will only perform the operations that you have performed in the past, without any drilling or tapping.

In the event this program goes as I think it can we should at some point give serious thought to manufacturing transducers for your requirements. With the volume potential that exists and the bad experience we have had with transducer manufacturers I am certain that we can get into the transducer business on a profitable basis.

I believe that you have a fine understanding of the problem and the ground rules defined so that the project can be pushed full bore during the next two weeks.

As soon as you begin to get some answers and the basic design is taking shape we should arrange a meeting, perhaps in Phoenix, with Larkin, Graham and myself, so that we can all review the project and carefully define our next step. I would like to do this sometime before the first of April. Please keep me advised.

Best personal regards.

J. R. Johnson

cc: Mr. Byron Langford
Mr. Keith Larkin - Plantronics - Santa Cruz.

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EP 007066
G276

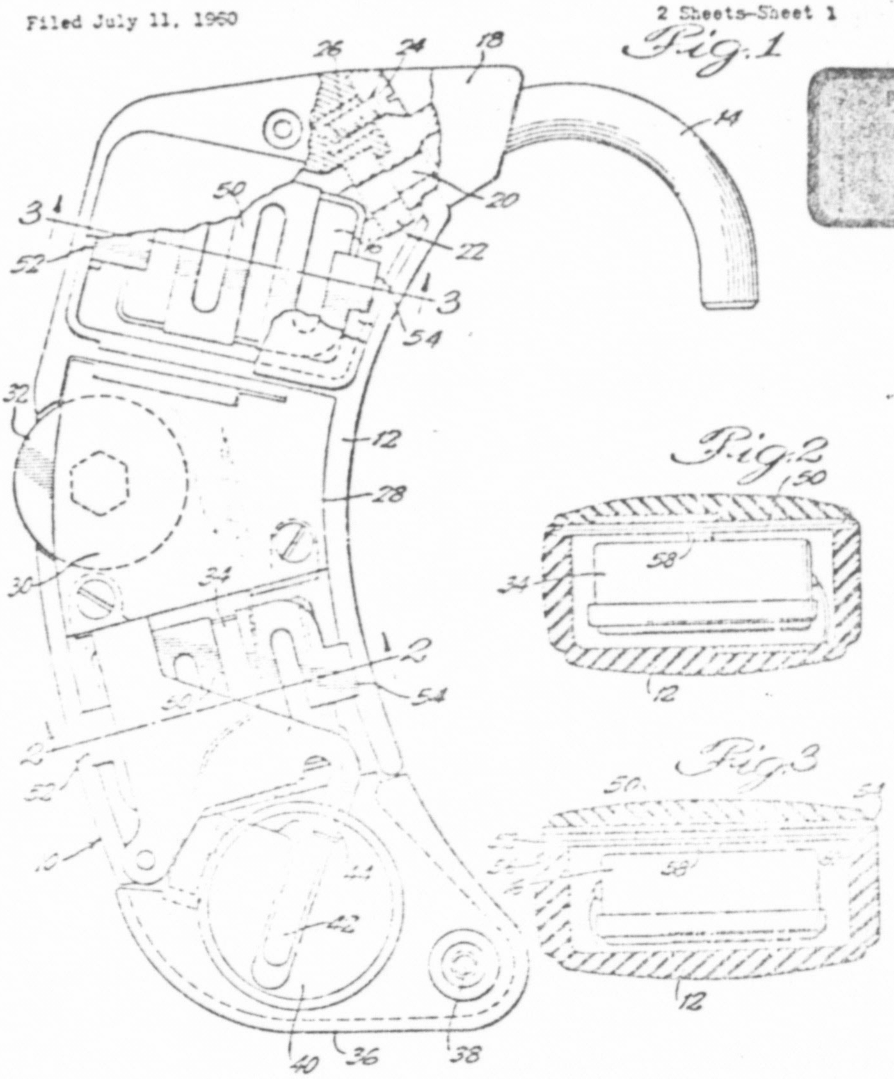
p 175

Ex 112 387

Jan. 30, 1962 E. M. WEISS 3,019,306

TRANSDUCER SUSPENSION

Filed July 11, 1960 2 Sheets-Sheet 1



INVENTOR:
Erwin M. Weiss,
BY
Davis, Freeman & Molinare
ATTORNEYS.

Ex. 113 388

Fig. 4

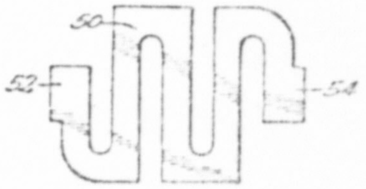


Fig. 5

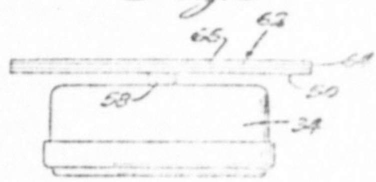


Fig. 6

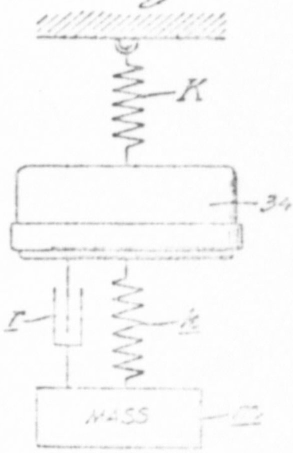


Fig. 7

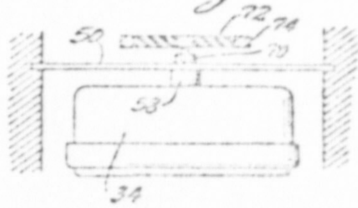


Fig. 8

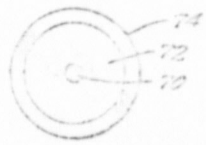


Fig. 10

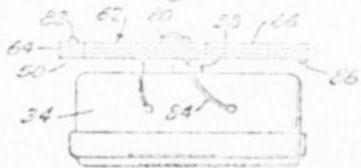
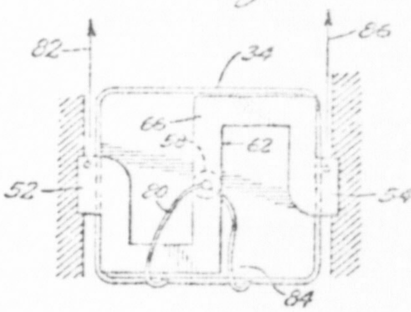


Fig. 9



INVENTOR:
Erwin M. Weiss,
BY
Bair, Freeman & Molinare
ATTORNEYS.

Ex. 108

United States Patent Office

3,019,306
Patented Jan. 30, 1962

1

3,019,306

TRANSDUCER SUSPENSION

Erwin M. Weiss, Chicago, Ill., assignor to Beltone Hearing Aid Company, a corporation of Illinois

Filed July 11, 1960, Ser. No. 42,152
10 Claims. (Cl. 179—146)

This invention relates generally to transducer suspension means, and more particularly to a new and improved means for mounting a transducer in a case, as for example, the case of a hearing aid of the type adapted to be worn on the head or body of a hard-of-hearing person.

Prior art means for mounting transducers in compact electrical apparatus, such as hearing aids, have certain characteristics in common. For example, those skilled in the hearing aid art know that some type of visco-elastic substance generally is used to suspend a microphone and a receiver within a hearing aid case. In some instances, the substance may take the form of a porous blown natural or synthetic rubber, and in other cases, this substance may take the form of a sheath of solid rubber.

A transducer mounting of the first type comprising suspension members of blown rubber cemented between the hearing aid case and the transducer is shown in Patent No. 2,894,076 granted to Sam Posen on March 17, 1959. In the second type of transducer mounting referred to above, the transducer is encased within a thin rubber enclosure and the entire assembly is positioned in the hearing aid case.

In order to provide proper isolation of a transducer within a rigid case, it is necessary that the visco-elastic substance interposed between the transducer and the case be very compliant. As a result, blown rubber mountings frequently are used but it is difficult to maintain uniformity therein due to the wide variations in the compliance characteristic which exists from batch to batch, and even from portion to portion within the same batch, in a blown rubber mounting.

Further, it usually is necessary to cement the blown rubber mounting to both the case and the transducer. Those skilled in the art appreciate that difficulties often arise from such an arrangement due to the tendency of the cement to wick by capillary action into the porous rubber material. As a consequence, the porous rubber material is stiffened considerably after the cement is dried and the compliant property which is desired is substantially lost. An additional difficulty arises when small sections of porous rubber are used in the form of buttons or washers. It is necessary to hold such parts to close dimensional tolerances due to the small size of the cavities in which the transducers are mounted, and it often is very difficult or even impossible to hold a piece of material with such poor dimensional stability as blown rubber to the desired close tolerances.

In those instances where a sheath of solid rubber is used to support a transducer within a case, other difficulties are encountered. For example, the compliance provided by such a solid rubber sheath is not very great, and consequently the transducer is not adequately isolated from case vibrations. Those skilled in the art appreciate that the poor isolation properties of a hard thin rubber sheath frequently necessitates considerable reduction in the average gain of the hearing aid.

It is further known that transducer mountings which utilize resilient rubber bumpers or washers form isolators which are compliant in horizontal as well as vertical modes. Thus, when a soft rubber bumper is used to support a microphone, the microphone tends to float sideways and as a consequence, the microphone may hit the case when the wearer moves his head sharply.

Accordingly, it is a general object of this invention to

2

overcome the above-stated difficulties which characterize the transducer mounting means of the prior art.

More particularly, it is an object of this invention to provide a new and improved transducer mounting means which is characterized by its uniform and lasting compliance properties, by its efficiency of isolation in a desired mode, and by its relatively simple and low cost construction.

In accordance with one specific illustrative embodiment of this invention, the novel transducer mounting means takes the form of a flat metallic spring which is shaped to provide considerable effective length in a small area. Advantageously, the flat metallic spring may comprise a plurality of beams connected in series with the opposed ends of the spring being fastened to the case and with the center beams being adapted to receive and support the transducer.

As explained in greater detail hereinbelow, the fundamental frequency of oscillation of the metallic spring isolator in combination with the transducer advantageously is made well below the lowest frequency to be amplified by the hearing aid. In addition, it is known that a transducer, such as a microphone, is much less sensitive to vibration in a horizontal plane than in a plane perpendicular to the diaphragm. The metallic spring isolator comprising the invention is made to be very stiff in a horizontal plane, but very compliant in the vertical plane so that a microphone may be supported in a small cavity with less concern about the problem of rapid head motion.

In accordance with a further feature of the invention, the metallic spring isolator is provided with particular damping means to prevent excitation into resonance at higher frequencies. Such damping means advantageously may comprise a visco-elastic substance sandwiched between the spring isolator and a thin sheet of metallic foil, or alternatively, it may take the form of a dynamic vibration absorber in which additional spring and mass means are secured to the spring isolator.

It is a still further feature of this invention to utilize the damped spring isolator as a two terminal electrical conductor to reduce lead breakage in the transducer. Thus, one electrical lead of the transducer is connected to the metallic spring of the isolator and the other electrical lead is connected to the metallic foil of the isolator. Since the connections are made at the geometric center of the suspension system where there is no relative movement between the transducer and the isolator, the leads are not caused to vibrate and breakage of the leads is substantially reduced.

The novel features which are characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a side elevational view of a behind-the-ear type of hearing aid, partly broken away and partly in section, embodying the present invention;

FIGURE 2 is a cross-sectional view of a microphone supported by a metallic isolator taken substantially as shown along line 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view of a receiver supported by a metallic isolator taken substantially as shown along 3—3 of FIGURE 1;

FIGURE 4 is a plan view of one specific illustrative embodiment of metallic isolator in accordance with the invention;

FIGURE 5 is an elevational view of a transducer supported by a damping metallic spring isolator;

FIGURE 6 is a schematic diagram of the electrical

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equivalent circuit of a damping dynamic vibration absorber in accordance with the invention;

FIGURES 7 and 8 are elevational and plan views respectively of one specific illustrative embodiment of a damping dynamic vibration absorber type of transducer isolator in accordance with the invention; and

FIGURES 9 and 10 are plan and elevational views respectively of a damped transducer isolator embodiment in which the metallic elements of the isolator also serve as a two terminal electrical conductor to reduce transducer lead breakage.

Referring now to the drawing, and more particularly to FIGURE 1 thereof, there is shown one specific illustrative embodiment of hearing aid in which a portion of the cover has been removed from the case to better illustrate the internal construction of the hearing aid. The present invention is shown in this application as used with a hearing aid for illustrative purposes only, and it will be obvious to those skilled in the art that the invention finds equally advantageous use in other types of compact, electrical devices which utilize a transducer, such as a microphone, a receiver, and the like.

FIGURE 1 shows a hearing aid of the type sometimes referred to as a behind-the-ear model, which is adapted to be supported upon the ear with the main case of the hearing aid resting on the back portion of the ear. As shown, the hearing aid 10 comprises a case 12 which advantageously is of channel shape to receive the hearing aid component therein. An air tube 14 extends from the upper end of case 12 and serves to convey sound from a receiver 16 within the case to a further air tube which extends into the ear of the hard-of-hearing person.

Those skilled in the art will appreciate that the air tube 14 advantageously may be formed of a stiff plastic material so that it may be shaped to fit the ear and rest comfortably thereon. The air tube 14 advantageously is embedded within the end piece 18, and is in sound communication with the receiver 16 through the aperture 20 in the nubbin provided in end piece 18, and through the sealing ring 22 positioned between the nubbin and the receiver 16. Advantageously, the end piece 18 may be secured to the hearing aid case 12 by means of any suitable fastener, such as the threaded screw fastener 24 which is positioned within a suitable threaded opening 26 in the hearing aid case.

In addition to the receiver 16, the hearing aid within the case 12 comprises an amplifier and control portion 28 which is positioned immediately adjacent the receiver portion 16. While the amplifier and control portion 28 is shown in FIGURE 1 as having a cover 30 thereover, it will be appreciated that the amplifier and control portion 28 may comprise any suitable transistorized amplifier and volume control assembly, the volume control being adjustable externally by means of volume control knob 32.

A microphone 34 is positioned adjacent the amplifier and control portion 28, and a combined On-Off switch and battery holder 36 is positioned adjacent the microphone. Advantageously, the combined On-Off switch and battery holder 36 is pivotally attached to the hearing aid case by means of the pivot member 38 so that the switch and battery holder 36 may be actuated to turn the hearing aid On or Off, or further actuated to be withdrawn from the case for replacement or checking of the battery. The switch and battery holder 36 is provided with the suitable central aperture 40 adapted to receive a battery therein and a pair of contacts 42 and 44 are provided for engaging the battery terminals in a selective manner to control the energized condition of the hearing aid.

While the details of the hearing aid shown in FIGURE 1 are described for purposes of illustrating one specific preferred embodiment of the invention, manifestly, the invention is not limited to the hearing aid of FIGURE 1 and may be used with equally advantageous results in

other hearing aids as well as other compact electrical structures employing transducers.

In accordance with a salient feature of this invention, the transducers of the hearing aid are suspended within the case in a unique and highly advantageous manner. The novel suspension means differs from the visco-elastic isolators and suspension means of the prior art and overcomes the difficulties associated therewith, as described in detail hereinabove.

One specific illustrative embodiment of transducer suspension means in accordance with the invention is shown in FIGURES 1, 2, 3, and 4, of the drawing. Advantageously, this illustrative embodiment takes the form of a flat, metallic spring which preferably comprises a plurality of sinuous beams and which further comprises an isolator secured to the geometric center of the flat, metallic spring for supporting the transducer in non-contacting relation with the spring and with the walls of the transducer case.

The nature of the properties required for a transducer suspension member of the type contemplated by the present invention are as follows. First of all, the fundamental frequency of oscillation of the suspension member in combination with the transducer must be well below the lowest frequency being amplified by the electrical device. For example, in the case of a hearing aid in which the lowest frequency being amplified is approximately 400 cycles, the transducer suspension member in combination with the transducer should have a natural period of oscillation of no greater than 100 cycles per second. Secondly, those skilled in the art will appreciate that a transducer, such as the microphone, is much less sensitive to vibration at a plane parallel to the microphone diaphragm than in a plane perpendicular to the diaphragm. As a result, the transducer suspension member advantageously is made very stiff in a horizontal plane but very compliant in the vertical plane. This requirement is admirably met by the present invention since the flat, sinuous, metallic spring has much greater stiffness in the plane in which vibration isolation is not required.

One practical result of this unique arrangement is the use of smaller cavities for the transducers. Thus, a microphone in the hearing aid, when suspended by the invention, may be placed in a small cavity with much less concern about the problem of rapid head motion than is the case with present day transducer suspension members.

A still further advantage of the flat, metallic transducer suspension member of the present invention is the fact that its properties can be held to very close tolerances. Thus, metallic materials, such as stainless steel, do not deteriorate with time as is the case of sponge rubber or other visco-elastic materials, and therefore the suspension member can be maintained to a desired degree of performance.

In the specific illustrative embodiments of transducer suspensions shown in FIGURES 1 to 4, the transducer suspension member 50 is a flat, metallic spring which is sinuous in shape and which is provided at its ends with the terminal pieces 52 and 54, respectively. The sinuous shape of the transducer suspension member 50 is highly advantageous to give the suspension member a greater effective length in a relatively small area. Those skilled in the art will appreciate that this action of the suspension member 50 may be viewed as the action of several springs in tandem. Effectively many beam means are provided in series to permit efficient isolation of the transducer from case vibration.

As shown in FIGURES 1, 2, and 3 of the drawing, the terminals 52 and 54 of the transducer suspension member 50 are positioned on the shoulders 56 and 58, respectively, of the transducer cavity provided in the hearing aid case. The transducer suspension member 50 can be held in position by any suitable means and the cover of the case is positioned thereover to maintain the suspension member securely in its desired position.

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FIGURE 2 shows the microphone 34 of the hearing aid as suspended from the transducer suspension member 50 by means of the isolator or separator element 58. Similarly, FIGURE 3 shows a receiver 16 of the hearing aid as suspended from the transducer suspension member 50 by means of the isolator element 58. In accordance with a feature of this invention, the isolator element 58 is mounted at geometric center of the transducer suspension element 50 so that the transducer is in non-contacting relationship with the suspension member 50 and further in non-contacting relationship with the walls of the transducer cavity in the case 12.

Due to the low internal damping of the flat metallic transducer suspension members 50, there is a possibility that such a member may be excited into substantial resonance at higher frequencies. In accordance with a further embodiment of this invention, such oscillation or vibration at higher frequency modes may be suppressed by providing sufficient damping for the metallic spring suspension member. Thus, as illustrated in FIGURE 5 of the drawing, a transducer such as the microphone 34 may be suspended by the isolator 58 from a transducer suspension member 62 of damped construction. As shown in FIGURE 5, the transducer suspension member 62 advantageously comprises a layer of visco-elastic material 64 which is sandwiched between a flat, metallic spring member 50 and a very thin layer of stiff constraining material, such as a sheet of aluminum foil 66. Those skilled in the art will readily appreciate that the damping action provided by the damped suspension member arrangement of FIGURE 5 will serve to inhibit or suppress any tendency of the transducer suspension member to vibrate at higher frequencies.

A still further embodiment of the invention which is adapted to provide greater isolation at frequencies above the natural period of the spring is shown in FIGURES 6 and 7 of the drawing. As illustrated in these figures, this embodiment comprises the transducer suspension element 50 described hereinabove and an isolator or spacer 58 secured to the suspension member, which in turn supports a transducer such as a microphone 34. In addition to these elements, which correspond to the construction described in respect to FIGURES 1 through 4, this embodiment further comprises an additional spacer or isolator 70 secured to the opposite side of the transducer suspension member 50 for supporting an additional spring and mass arrangement to provide damped dynamic vibration absorption.

The equivalent circuit for the damped dynamic vibration absorber is shown in FIGURE 6 of the drawing wherein the microphone 34 is shown as suspended by a spring element K. Spring element K corresponds to the spring suspension provided by the transducer suspension member 50. Suspended from the microphone 34 is shown an additional spring k and an additional damping means r, shown in parallel and supporting an additional mass m. The additional spring damping means and mass are provided in one practical form of such a suspension by a thin, rubber disc 72 mounted on the isolator 70. The additional mass m is provided by the actual effective mass of the rubber disc 72 and the additional spring k is provided by the compliance of the rubber disc 72 when it vibrates in the "umbrella mode."

In another embodiment of the damped dynamic vibration absorber arrangement, the total mass would be the actual effective mass of the rubber disc 72 in addition to the mass of an annular lead ring 74 positioned around the rubber disc 72. Thus, the mass element m could be provided by a rubber disc alone or by the combination of a rubber disc and a metal ring therearound.

One typical value for such mass would be approximately ⅓ of the mass of the transducer. Thus, in a microphone having a mass of 2 grams, for example, the mass of the damped dynamic vibration absorber element would be approximately $\frac{6}{10}$ of a gram.

While many other embodiments of transducer suspension members will be suggested in accordance with the teachings of the present invention, the above specifically described embodiments are merely illustrative of several practical forms of the invention to comply with the requirements of the patent statutes.

In addition to overcoming many of the problems of prior art visco-elastic transducer suspension members, the transducer suspension member of the invention also may be used in providing highly efficient acoustic isolation between a receiver and a microphone in a hearing aid case. Thus, those skilled in the art know that a certain amount of the acoustic output from the receiver normally is incident upon the microphone within the same hearing aid case. Some of this output comes from the leaks around joints, which usually are in the places where the receiver is connected to the nubbin.

The output then travels to the microphone through the case cavity. Some acoustic output may be radiated into the case cavity from the vibration on the walls of the receiver itself. If a receiver in a a hearing aid is viewed as a miniature loud speaker, it can be appreciated how sound pressure developed in the receiver can vibrate the walls of the receiver case. This acoustic output adds to the acoustic output leaks and also reaches the microphone.

In accordance with a feature of this invention, such acoustic feedback may be reduced for transducers suspended by flat, metallic spring suspension members 50 by placing the entire receiver in a sealed cavity with stiff walls, or by molding a simple acoustic attenuator into the hearing aid case. In the latter, such an attenuator may take the form of a quarter-wave acoustic trap for frequencies at which the receiver develops its peak output.

Another highly advantageous embodiment of the invention is illustrated in FIGURES 9 and 10 of the drawing. Those skilled in the art will readily appreciate that the vibration of a transducer during its normal operation frequently results in breakage of the relatively thin transducer electrical leads. This serious problem is overcome in accordance with a feature of the invention by the utilization of the metallic elements of the damped vibration isolator of FIGURE 5 as two terminal electrical conductors. Thus, as shown in FIGURES 9 and 10, the transducer 34 normally is provided with the electrical conductor leads 80 and 84. One lead 84 is electrically connected to the metallic spring member 50 of the suspension member 62 and the other lead 80 is electrically connected to the sheet of metallic foil 66 positioned on the layer of visco-elastic material 64 opposite the spring member 50.

Preferably, the points of connection for each of the leads is at the geometric center of the suspension system. Since there is no relative motion between the transducer 34 and the geometric center of the suspension system the leads 80 and 84 are not caused to vibrate and the breakage problem is substantially reduced. The electrical output from the transducer 34 is obtained from the two conductors 82 and 86 attached to the extreme ends of metallic elements 66 and 50 respectively. As the extreme ends of the spring 50 are supported by the case wall, there is no relative motion on these points. Consequently, relatively heavy electrical leads 82 and 86 may be affixed in a suitable manner at these points to carry the electrical output from the transducer to the electrical amplifying system of the hearing aid or other compact electrical device.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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What I claim as my invention is:

1. The improvement of transducer mounting means for supporting a transducer within a hearing aid case comprising a plurality of sinuous, series connected beams secured to the walls of a transducer cavity within the case, a transducer, attachment means secured to said beams and supporting said transducer in non-contacting relation with said beams within said transducer cavity, said transducer also being supported by said attachment means in non-contacting relation with the walls of said transducer cavity.

2. The improvement of transducer mounting means for supporting a transducer within a cavity in a hearing aid case comprising flat, metallic beam means, said beam means comprising a plurality of series connected beams having a pair of opposed terminal ends secured to the walls of said case, a transducer, attachment means secured to said beam means and to said transducer for supporting the latter in non-contacting relation with said beam means within said transducer cavity.

3. The improvement of transducer mounting means for supporting a transducer within a hearing aid case comprising flat, resilient beam means secured to the walls of a transducer cavity within the case, a transducer, separator means geometrically centered on said beam means and supporting said transducer in non-contacting relation with the walls of said transducer cavity, and damping means secured to said beam means for damping vibrations at higher frequencies to prevent said beam means from becoming excited into resonance at such higher frequencies.

4. The improvement of transducer mounting means in accordance with claim 3 wherein said damping means comprises a layer of a visco-elastic material adjacent said beam means and a sheet of stiff constraining material positioned on the visco-elastic layer.

5. The improvement of transducer mounting means in accordance with claim 4 wherein said sheet of stiff constraining material is [illegible] aluminum foil.

6. The improvement of transducer mounting means for supporting a transducer [illegible] comprising flat, metallic beam means secured to the walls of a transducer cavity [illegible] isolator means located at the geometric center of one side of said beam means and supporting said transducer in

non-contacting relation with the walls of said transducer cavity, second isolator means located at the geometric center of the other side of said beam means, and damped dynamic vibration absorber means supported by said second isolator means.

7. The improvement of transducer mounting means in accordance with claim 6, wherein said damped dynamic vibration absorber means comprises a thin resilient disc, the mass of said disc serving as the mass of the vibration absorber means and the compliance of said disc serving as the spring of said vibration absorber means.

8. The improvement of transducer mounting means in accordance with claim 7 further comprising an additional mass for said vibration absorber means formed of an annular lead ring mounted around said resilient disc.

9. The improvement of transducer mounting means for supporting a transducer within a case containing electrical circuitry comprising flat, resilient, metallic beam means secured to the walls of a transducer cavity within the case, a transducer, separator means secured to said beam means and supporting said transducer in non-contacting relation with the walls of said transducer cavity, damping means secured to said beam means for damping vibrations at higher frequencies, said damping means comprising a layer of visco-elastic material positioned on said metallic beam means and a sheet of thin metallic foil positioned on said visco-elastic layer, and means connecting one electrical lead of said transducer to the metallic beam means and the other electrical lead of said transducer to the sheet of metallic foil whereby the latter serves as two conductive terminals for connecting said transducer to the remainder of the electrical circuit.

10. The improvement of transducer mounting means in accordance with claim 9 wherein said transducer electrical leads are connected to the geometrical centers of said beam means and metallic foil sheet to minimize vibration of said leads and thereby reduce lead breakage problems.

References Cited in the file of this patent

UNITED STATES PATENTS

[illegible] Sauer et al. [illegible] Oct. 28, 1941

FOREIGN PATENTS

[illegible] [illegible] Apr. 14, 1942

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(300)

PLAINTIFF'S EXHIBIT 120

ROANWELL CORPORATION

Series 70 Development

Report for Period October 22, 1969 through November 7, 1969

At our meeting in New York on October 22nd, it was decided that adjustable means were necessary to fit all types and sizes of ears, and that an under the ear lobe hook was needed for good stability with all types of units.

During the following week various type of hooks were tried and six dummy models were prepared for running, preference and fit tests on both male and female ears. The result of limited local tests were tabulated and at a visit here by Mr. Nol, on October 30, it was decided to narrow the models down to two types and proceed with working models of each. One model to be similar to the P. P. I. design with over-the-ear input pipe, but with Roanwell transducers, and the other model to be the most acceptable flat type behind-the-ear unit with over-the-ear output.

We also decided to add a plug-in cord, as featured by P. P. I. Therefore, new details and drawings were made for a first model of each configuration and model case, boot, swivel and other parts started for getting a first working model of the newest flat type. Hopefully, this will be ready during the week of November 17, to be followed by the P. P. I. type as soon as the necessary new parts can be made.

A drawing of the layout for the first working model is enclosed, as well as an accounting of engineering and travel time spent to date.

N. S. Nichols
11/7/69

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Ex 120 (394)

HATHORNE, MASSACHUSETTS 01937 / (DANVERS) / (617) 774-3300

PLAINTIFF'S EXHIBIT 121

12
Twelfth Annual Wescon Industrial Design Awards

6515

Ex. 121 (345)

Twelfth Annual Wescon Industrial Design Awards

Yearbook of the Industrial
Design Awards exhibited at the
Western Electronic Show
and Convention

Hollywood Park, Los Angeles
August 25-28, 1970

Wescon Sponsors: San Francisco Section and
Los Angeles Council, representing
the 6th Region, Institute of Electrical
and Electronics Engineers, and Western Electronic
Manufacturers Association

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StarSet Communications Headset, Model HS0103

Pacific Plantronics, Inc., Santa Cruz, California

Product size and weight: ½ ounce.

Typical product application. To replace conventional telephone handset or heavier-weight head-set in high-use telephone situations.

Advantages over products previously available: Compared to telephone hand-set: hands are freed to check files, write orders, etc. Compared to other head-sets: no headband to cause fatigue or muss hair, extremely light weight, inconspicuous.

Design problem: Parameters — (1) Headset to be miniaturized and inconspicuous when worn. (2) Should not require a headband. (3) Weight less than one ounce, excluding cord and plug. (4) [illegible] of the head with or without glasses. (5) [illegible] and earpieces [illegible] different [illegible] [illegible] for manufacture in high volume [illegible].

Design solution: [illegible] headset capsule is designed to fit behind the ear, [illegible] projecting over saddle of ear. A high degree of stability is obtained by the voice tube emanating from the top of the capsule where it is anchored by the ear saddle and earpiece tube curving round the bottom of the ear. It can be worn with glasses. The capsule is molded in Polycarbonate, ultrasonically welded, weighs ½ ounce. Voice sounds are conducted to the microphone through an acoustic tube consisting of a metal section on a ball joint at the capsule to adjust angle, and a curved transparent plastic section which slides over the metal section to adjust length. Sounds from the receiver are directed to the ear through a flexible tube to which a soft plastic tip is permanently attached. Earpieces are supplied in 6 sizes. The thin tinsel cable plugs into the rear of the capsule and is fitted with a strain relief device which slides along the cable to a convenient position, then is clipped to the users clothing. The eight transistor amplifier, housed in the plug, is designed to automatically reduce gain when user is not speaking, thus reducing effects of ambient noise.

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Starset Communications Headset

Pacific Piantronics Inc

Product Design Manager: Kenneth J. Hutchings
Chief Engineer: Robert J. Bernardi
Research and Development: Donald R. Wilson

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Criteria for Judging

Judging of entries will be based on industrial design content in a product, where the problem has included design engineering parameters of performance and function. Creative industrial design solutions in such areas as visual clarity and organization, safety and human engineering, selection and use of materials, ease of manufacture, ease of use, ease of maintainability, and esthetically appropriate appearance and identity (particularly where it may enhance marketability) will be considered."

Industrial Design Judging Committee

William M. Goldsmith, FIDSA
Dave Chapman, Goldsmith & Yamasaki, Inc.

G. Craig [illegible], IDSA
Ford & Earl Design Associates

Daniel S. [illegible]
Raychem Corporation

Deane Richardson, IDSA
Richardson/Smith Inc.

Arthur J. Pulos, FIDSA
Syracuse University

Production notes

This book is set in the Helvetica family of typefaces.

The paper stocks are [illegible]
Cover C1S [illegible]
and 100# Paloma [illegible]

Graphic design: [illegible]

Typography: [illegible]

Photography: [illegible] Studio

Lithography: [illegible]